2018 New Mexico State Water Plan

Part I: Policies

Part II: Technical Report

Part III: Legal Landmarks

Adopted by the New Mexico Interstate Stream Commission

December 6, 2018

Office of the State Engineer

Interstate Stream Commission

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December 6, 2018

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of the 2018 New Mexico State Water Plan

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NEW MEXICO INTERSTATE STREAM COMMISSION

December 6, 2018

RE: 2018 New Mexico State Water Plan

Dear New Mexicans:

The New Mexico Interstate Stream Commission and the New Mexico Office of the State Engineer are pleased to present this ***2018 New Mexico State Water Plan,*** prepared in accordance with NMSA §72-14-3.1.

Organization

The ***2018 New Mexico State Water Plan*** includes three parts:

2018 New Mexico State Water Plan Part I: Policies presents a concise, big-picture view of the highest priority water issues in New Mexico and the policies, goals, and strategies needed to address them, as well as information about the agencies and resources available to assist with these issues.

The eight policy topics include:

1. **Water Infrastructure**
2. **Data Collection, Accessibility, and Monitoring**
3. **Drought**
4. **Watershed Management**
5. **Water Supply and Demand**
6. **Water Conservation**
7. **Water Quality**
8. **Water Planning**

2018 New Mexico State Water Plan Part II: Technical Report integrates water resource information from the Regional Water Plans completed in 2016-2017, including estimated water supply and demand, projections of population, and strategies proposed by stakeholders to address key water issues.

2018 New Mexico State Water Plan Part III: Legal Landmarks provides information about historical New Mexico water law decisions, events, and circumstances that shaped New Mexico's legal structures for water resource administration.

The ***2018 New Mexico State Water Plan*** is a strategic management tool to assist and inform decision-makers at all levels, ranging from legislators to citizens, in addressing water resource issues. The plan provides a range of strategies for consideration in addressing the diverse and complex water issues facing New Mexico.

Relation to Previous Water Planning Efforts

The ***2018 New Mexico State Water Plan*** builds on earlier water planning work in New Mexico. The *2003 New Mexico State Water Plan* outlined goals and strategies organized by statute (State Water Plan Act) that overlap many of the recommended strategies in ***2018 New Mexico State Water Plan Part I: Policies.*** Like the 2003 plan, the 2018 plan does not attempt to prioritize one strategy, or one type of water use over another, but instead reflects the common priorities and objectives that were identified during the regional water planning process and in the December 2017 State Water Plan Town Hall.

New Mexico's State Water Plan presents a generalized assessment of the current and future water supply and demand statewide to provide decision-makers with a basic understanding of the water resource problems facing New Mexico. It is a living document and will continue to be updated. While the 2003 plan was organized by each statement in the State Water Plan Act, the 2018 plan is organized by objectives that arose from the regional water plans and the 2017 Town Hall. The objectives and strategies presented in the 2003 plan remain valid and are consistent with the policies included in this 2018 plan. Accordingly, the eight policy topics presented in the 2018 plan are complementary to, and not intended to replace, policies from the 2003 plan.

The 2018 plan also addresses some of the unfinished tasks of the 2003 plan. For example, the State Water Plan Act states that regional water plans must be integrated into the State Water Plan. This was not possible until the *2013 Updated Regional Water Planning Handbook: Guidelines to Preparing Updates to New Mexico Regional Water Plans* was revised to include a standardized method of estimating water supply, demand, and population for each planning region, which provided the basis for the water supply and demand estimates presented in this ***2018 New Mexico State Water Plan Part II: Technical Report.***

The 2013 Handbook was also revised to provide a framework for capturing the infrastructure needs of the planning regions; thus, the recent update of the regional water plans includes detailed lists of the projects, programs, and policies that are needed to address local and regional problems. The New Mexico Interstate Stream Commission appreciates the input by the numerous stakeholders to help capture the infrastructure needs of the regions and help build a foundation for estimating the costs statewide for addressing infrastructure needs and other projects, programs, and policies. Costs were provided for about 60% of the suggested programs, policies, and projects, with an estimated total cost of $4.3 billion over the next few years.

The New Mexico Interstate Stream Commission would like to thank the many individuals and organizations who reviewed the draft state water plan and provided thoughtful comments to help improve it. The input from all these entities, including federal and state agencies and pueblos in New Mexico, have offered valuable constructive feedback, and helped to identify many areas for future collaboration.

Going forward, the New Mexico Interstate Stream Commission Water Planning Program intends to initiate additional water planning outreach and education activities in 2019 and beyond. Upcoming events will be designed to address each topic. Future goals include convening a diverse range of participants and engaging in information-sharing, collaboration, and problem-solving to improve New Mexico water planning efforts.

See you there.

Sincerely,

Lucia F. Sanchez

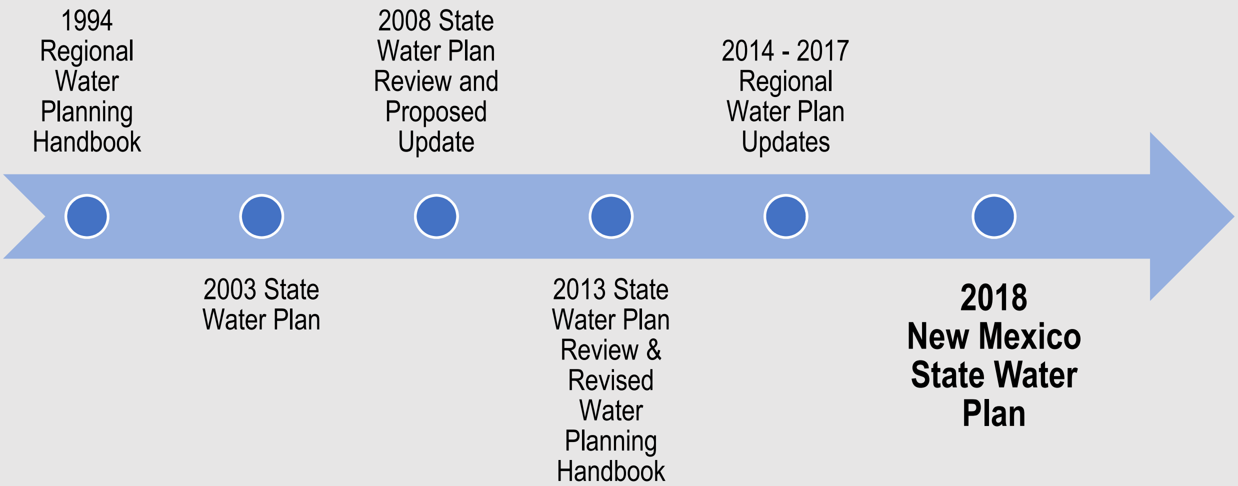
Water Planning Program Manager

New Mexico Interstate Stream Commission

Overview of State Water Planning in New Mexico and Statutory Authority

The state of New Mexico's first water plan was written in 2003 and has continued to evolve over the past 15 years. Since the original plan was written, the New Mexico Interstate Stream Commission has continued to develop other water planning reports and reviews focused on changing conditions that impact the state's water resources.

Below is a timeline showing some of the significant achievements in the history of regional and state water planning in New Mexico.



The 2003 State Water Plan Act defines the requirements of State Water Plan (NMSA §72-14-3.1 (C)(11)). The act also directs the New Mexico Interstate Stream Commission, in collaboration with the state engineer and the water trust board and in consultation with other government agencies as appropriate, to develop a comprehensive, coordinated state water plan (NMSA §72-14-3.1 (C)(11)). The 2003 State Water Plan addressed each section of the statute and provided strategies for meeting the purposes of the statute.

The *2008 Review and Proposed Update to the New Mexico State Water Plan* identified the strengths and weaknesses of the *2003 State Water Plan* and recommended that the next plan could be improved by including:

- Technical studies that address water supplies, population projections, water demand, the connection between groundwater and surface water, water conservation, drought management, brackish water and desalination, water availability and land use planning, and riparian restoration for protection of water supply and water quality.
- Increased emphasis on infrastructure needs, priorities, and costs.
- Identification of additional authorities and responsibilities of relevant agencies.
- More emphasis on ecosystem and habitat protection and restoration issues.

Purposes of the State Water Plan Act

- Promoting stewardship of the state's water resources
- Protecting and maintaining water rights and their priority status
- Protecting the diverse customs, culture, environment and economic stability of the state
- Protecting both the water supply and water quality
- Promoting cooperative strategies, based on concern for meeting the basic needs of all New Mexicans
- Meeting the state's interstate compact obligations
- Providing a basis for prioritizing infrastructure investment
- Providing statewide continuity of policy and management relative to our water resources

The New Mexico Interstate Stream Commission established a process to respond to the *2008 Review and Proposed Update to the New Mexico State Water Plan* and ultimately worked to improve the next State Water Plan. This process involved updating the regional water planning handbook.

The *2013 State Water Plan Review* described the approach for updating the regional water plans, including using the revised *2013 Regional Water Planning Handbook,* an update to the 1994 Handbook. The 2013 Handbook made technical studies more useful to the state water planning effort by creating a method, called the common technical approach, of evaluating regional water supplies to be consistently used in all regional water plans. This allowed the state to meet the statutory requirement that regional water plans be integrated into the State Water Plan (NMSA §72-14-3.1 (C)(11)).

The New Mexico Interstate Stream Commission developed this 2018 plan in accordance with the statute and chose a structure for this plan to group the large amount of information: ***Part I: Policies, Part II: Technical Report,*** and ***Part III: Legal Landmarks.*** This 2018 plan is intended to complement, not replace, the 2003 plan. Nothing in this State Water Plan shall be construed to grant or recommend the condemnation of water rights. Nothing in this State Water Plan shall be construed to determine, abridge or affect the water rights of Indian nations, tribes, or pueblos.

Using the 2013 Handbook's guidance, the New Mexico Interstate Stream Commission worked to compile water supply, population, and demand data in a consistent format for the 16 water planning regions. Thus, this ***2018 New Mexico State Water Plan*** evolved from the 16 regional water plans completed in 2016 and 2017, which were developed using the common technical approach. The common technical approach provided a first step toward planning consistently on the local level and will continue to be revised and improved in future iterations of water planning.

In addition, to add emphasis on infrastructure needs as recommended in the 2008 Review, the recent update of the regional water plans included information about the proposed projects and costs. The 2013 Handbook stated that the regional water plans should include a detailed list of the various projects, programs and policies (PPPs) that are needed to address local and regional problems. The PPP lists served as a foundation for identifying the infrastructure needs statewide and provided insight into the issues and problems facing each region.

To identify additional authorities and responsibilities of relevant agencies, each of the policy topics described in the ***2018 New Mexico State Water Plan Part I: Policies*** includes a figure to illustrate the various agencies involved and a directory showing the agencies and programs involved in either funding or overseeing the vast and complicated institutional structure for protecting and managing the state's water resources. Also, to provide more focus on ecosystem and habitat health, as recommended in the 2008 Review, this ***2018 New Mexico State Water Plan*** includes a policy topic of watershed management.

Office of the State Engineer

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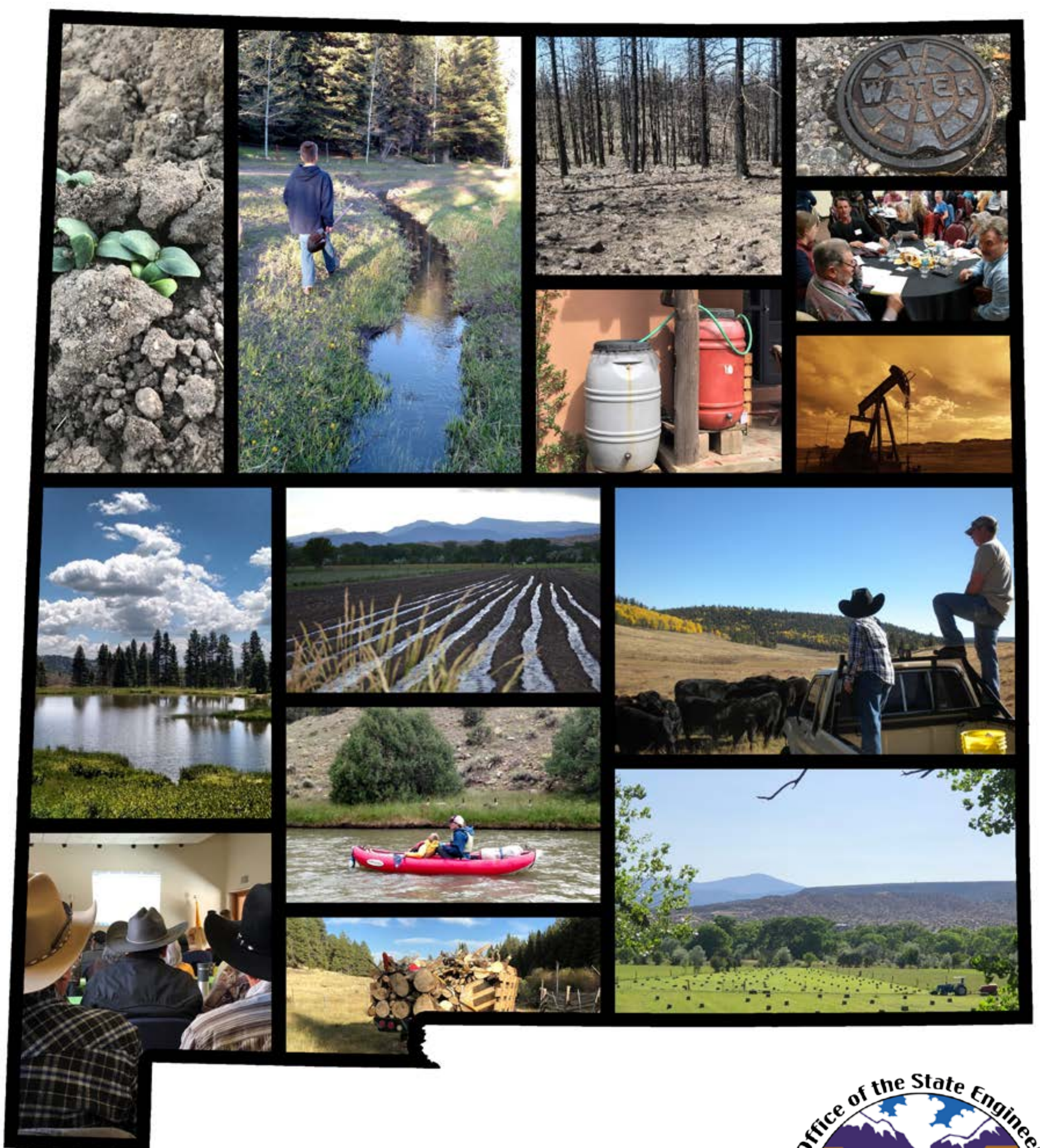
Interstate Stream Commission

NEW MEXICO STATE WATER PLAN
PART I: POLICIES

Gaining a Statewide Perspective through Analysis and Integration of
Water Planning Activities, Including New Mexico's 16 Regional Water Plans



Adopted by the New Mexico Interstate Stream Commission
December 6, 2018

Office of the State Engineer
Interstate Stream Commission

New Mexico State Water Plan Part I: Policies

Prepared by the New Mexico Interstate Stream Commission

Published 2018

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Part I: Policies presents a concise, big-picture view of the highest priority water issues in New Mexico and the policies, goals, and strategies needed to address them, as well as information about the agencies and resources available to assist with these issues.

Part II: Technical Report integrates water resource information from the Regional Water Plans completed in 2016-2017, including estimated water supply and demand, projections of population, and strategies proposed by stakeholders to address key water issues.

Part III: Legal Landmarks provides information about historical New Mexico water law decisions, events, and circumstances that shaped New Mexico's legal structures for water resource administration.

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List of Acronyms and Abbreviations

AWRM	Active Water Resources Management
BIA	United States Bureau of Indian Affairs
CDC	Center for Disease Control, United States
DHSEM	Department of Homeland Security and Emergency Management
FEMA	Federal Emergency Management Agency
GIS	geographic information system
gpcd	gallons per capita per day
ISC	New Mexico Interstate Stream Commission
NGO	non-governmental organization
NASS	National Agriculture Statistics Service
NEPA	National Environmental Policy Act
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMDFA	New Mexico Department of Finance and Administration
NMAC	New Mexico Administrative Code
NMDA	New Mexico Department of Agriculture
NMDGF	New Mexico Department of Game & Fish
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMEMNRD	New Mexico Energy, Minerals, and Natural Resources Department
NMFA	New Mexico Finance Authority
NMSU	New Mexico State University
NIDIS	National Integrated Drought Information System
NMWQCC	New Mexico Water Quality Control Commission
NRCS	Natural Resources Conservation Service
NOAA	National Oceanic and Atmospheric Administration
NWIS	National Water Information System
NWS	National Weather Service
NMWRRS	New Mexico Office of the State Engineer Water Rights Reporting System
ONRT	Office of the Natural Resources Trustee
OSE	New Mexico Office of the State Engineer
PPP	Projects, Programs, and Policies
PWS	public water system *or* public water supplier
SLO	New Mexico State Land Office
SNOTEL	Snow Telemetry
STORET	USEPA Water Quality Database (STOrage and RETrieval)
SWCD	Soil and Water Conservation Districts
URGWOM	Upper Rio Grande Water Operations Model
USBOR	United States Bureau of Reclamation
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFSA	United States Farm Service Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USIBWC	International Boundary and Water Commission
USR	Underground Storage and Recovery
WIPP	Waste Isolation Pilot Plant
WRRI	New Mexico Water Resources Research Institute
WWTP	Wastewater Treatment Plant

Introduction

New Mexicans are actively restoring and protecting water resources, as well as planning for future water demand and climatic conditions. Supporting the culture and ecosystems within the state, protecting existing supplies, meeting future water demands, and enhancing water system and watershed resilience in light of changing conditions are goals to guide management of the state's water resources.

The actions required to achieve these goals are vast, complex, ambitious, and infinitely worthwhile. Many of the strategies for meeting the goals for managing our water resources are already in place, while other strategies need much more work to be realized.

Purpose of the 2018 New Mexico State Water Plan Part I: Policies

This *2018 New Mexico State Water Plan Part I: Policies* presents a concise, big-picture view of the highest priority water issues in New Mexico, along with the policies, goals, and strategies needed to address them, as well as information about the agencies and resources available to assist with these issues. These policies reflect the water resource issues and proposed strategies that were identified in the regional water planning process and in the 2017 State Water Plan Town Hall.

The 2016-2017 Regional Water Plan updates, representing the 16 water planning regions of New Mexico, provided information regarding key water issues, recommendations to the state, and over 2,600 regional suggestions for projects, programs, and policies (PPPs); in addition, the 2017 State Water Plan Town Hall identified 33 recommendations. The greatest concerns and proposed actions for each policy topic have been synthesized from these sources. Identified issues and strategies were compiled and organized by their objectives to identify the common priorities that arose from these public outreach and regional planning efforts.

Policies were selected for the eight topics that repeatedly appeared in stakeholder meetings, regional water planning, and the town hall event. This document can be used by decision-makers and individuals seeking to better understand rules and regulations and government agencies tasked with managing and protecting New Mexico's water resources. It is also designed to be helpful in identifying resources for specific water issues and for pursuing funding opportunities.

While the 2003 plan was organized by each statement in the State Water Plan Act, the 2018 plan is organized by objectives that arose from the regional water plans and the 2017 Town Hall. The objectives and strategies presented in the 2003 plan remain valid and are consistent with the policies included in this 2018 plan. Accordingly, the eight policy topics presented in the 2018 plan are complementary to, and not intended to replace, policies from the 2003 plan.

Overview of Policies

The highest priorities for the state are presented here, organized into eight policy topics, along with a brief summary of the key findings.

1. Water Infrastructure Policy

The state of New Mexico has significant water infrastructure repair and improvement needs for both the agricultural and public water use categories. These needs should be conveyed at the federal level to maximize federal matching funds while efficiently utilizing available state and local funding.

2. Data Collection, Accessibility and Monitoring Policy

The state of New Mexico needs to continue its steady improvement in measurement and estimation of water diversions, depletions, and return flows. In addition, the state should develop or expand the existing databases and create a centralized platform for managing measured or metered water diversions. The state of New Mexico also needs to continue to coordinate with multiple agencies to determine data gaps in monitoring networks, update surface water and groundwater models, and consider other needs for centralizing water resources data. The process of developing the *2018 New Mexico State Water Plan* was helpful in strengthening this interagency coordination.

3. Drought

The state of New Mexico needs to continue to monitor and assess drought conditions, as well as promote and incentivize the development of drought mitigation and response plans by local, state, and tribal agencies in the state.

4. Watershed Management

The state of New Mexico and tribal, federal, and private land managers should intensify efforts to manage forests, rangeland, urban, and riparian areas in order to improve resilience to drought, fire, and severe storm events. Funding entities such as the New Mexico Legislature should prioritize funding for planning and implementing forest treatments, particularly in watersheds that impact streams which supply or deliver surface water to public water systems.

5. Water Supply and Demand

While each public water system, irrigation district, acequia, and other self-supplied water user in the state is tasked independently with managing its own supply as well as forecasting and meeting future demands, the state of New Mexico must manage the resource to protect senior water right holders and to comply with interstate water compacts. The most glaring extreme water supply shortfall is occurring in eastern New Mexico, where some communities are projected to have fewer than five years of water supply remaining at current depletion rates. State and federal agencies should support water supply projects, especially diversions such as from Ute Reservoir, due to the severe dewatering of the High Plains aquifer.

6. Water Conservation

Mechanisms to promote and incentivize water conservation should be explored and implemented by all state, federal, tribal and local governments, public and private water systems, and individual water users. In the agricultural water use category, which is by far the largest water consumer in the state, conservation incentives need to be developed to prevent increased depletions. Water conservation in the agricultural category should be implemented in locations where the hydrologic setting does not result in unintended consequences of reducing the return flow required by downstream users.

7. Water Quality

The agencies and programs in place to protect water quality for humans and the ecosystem should continue to be supported. A funding source should be identified to address lingering contamination in groundwater not covered by the Corrective Action Fund.

8. Water Planning

The New Mexico Interstate Stream Commission (ISC) should continue to conduct water planning through collaboration with state, tribal, and federal agencies, non-governmental organizations (NGOs), and other stakeholders to help move the state forward and improve the outlook for New Mexico's economy, environment, and cultural heritage.

The goals and strategies for each of the policies are numbered primarily for ease of discussion; they are not listed in order of importance or with any intention to connect certain goals to strategies. The strategies discussed here are not an all-inclusive set of solutions to the many water challenges facing New Mexico. Rather, the strategies are recommendations expressed by various stakeholders around the state to address each goal.

Each policy topic also includes an accompanying figure to illustrate some of the statutes, rules, and regulations associated with that water policy topic; as well as the agencies, institutions, and organizations currently working to implement those rules and regulations. Also, for each policy topic, a table of information is provided about the critical organizations providing regulation, guidance, and/or resources related to the policy topic, including hyperlinks to each agency's website and specific programs or resources, and is intended to serve as a directory.

As part of the dynamic nature of the State Water Plan, the ISC expects further conversation about those priorities and about how they will be applied in concrete situations. This document attempts to capture the existing local, tribal, state, and federal agencies tasked with reaching the goals and implementing the strategies associated with the policy topics.

Each strategy on its own could be worthy of a separate plan, and this document only provides a very brief overview and a road map to finding important information. Going forward, the ISC will convene stakeholders to discuss the policy topics, goals, and strategies and work together to determine how to actively engage in implementing strategies. Appendix 1A presents feedback received from reviewers on the type of meetings that would be most helpful in moving forward.

1. Water Infrastructure Policy

Water infrastructure is the backbone for storing and delivering water to New Mexicans and providing protection from floods. The State Water Plan Act at NMSA §72-14-3.1 (C)(13) states that the plan shall "identify water-related infrastructure and management investment needs and opportunities to leverage federal and other funding."

Photo 1. Elephant Butte Dam.
Photo credit: Chris Stageman

This infrastructure includes but is not limited to large reservoirs that store water for later use (such as the Navajo and Elephant Butte reservoirs); dams for flood control; river diversion structures, canals, and drains for irrigating agricultural lands; levees that protect homes and land; groundwater wells, pumps, storage tanks, and pipelines for delivering water to cities; sewer lines and systems for treating water from homes and cities, stormwater infrastructure; and much more. This infrastructure is a multi-billion-dollar investment in New Mexico that must be maintained and improved over time.

Existing infrastructure requires continued repairs, maintenance, and expansion for the storage, conveyance, and delivery of water to the end user. Wastewater effluent must be collected and treated to protect not only downstream communities and groundwater, but also the health of the river systems. Levees, dam safety measures, and stormwater infrastructure are also essential to public safety and welfare.

Infrastructure needs for existing and new public water and wastewater systems, agricultural water systems, reservoir management, levees, and stormwater comprised more than half of the PPPs detailed in the 2016-2017 Regional Water Plan updates (ISC, 2016-2017). Estimated costs for 61% of the projects were provided. Those estimated costs totaled $4.3 billion. Costs estimated for public water and wastewater systems alone was estimated for 83% of the state's total water infrastructure projects at $3.1 billion (see *Part II: Technical Report, Section 6.6*).

Much of the water infrastructure on New Mexico's major rivers, which many New Mexicans rely on for all or a part of their water supply, was constructed and is operated and maintained by the federal government. Some costs and risks are also borne by the state of New Mexico and its water users.

New Mexico, largely through the ISC and New Mexico Department of Game and Fish (NMDGF), participates in forums and programs with the federal government, designed to aid the federal agencies in their operation of infrastructure projects to meet Endangered Species Act (ESA) and National Environmental Policy Act (NEPA) compliance activities, while reducing the potential impact on water users. These efforts, conducted primarily on the San Juan, middle Rio Grande, and Pecos rivers, require the State to share costs and resources for the system to be maintained.

The numerous organizations involved in designing, building, maintaining, and funding infrastructure projects are shown on Figure 1, along with the legal authorities related to programs that support infrastructure. Table 1 is a directory of critical government agencies which provide funding and/or are responsible for permitting infrastructure projects.

Water Infrastructure Goals

1. Maintain and operate properly functioning water systems.
2. Maintain and operate properly functioning wastewater systems.
3. Develop water and wastewater systems of sufficient capacity.
4. Replace use of potable water for non-potable use with alternative sources, such as treated effluent or desalination of brackish water, when possible and economically feasible.
5. Protect communities from floods.
6. Protect water quality.
7. Protect human health.
8. Reduce costs of infrastructure management.
9. Improve system efficiency, including reducing energy costs to pump water, or treat wastewater, or other actions which reduce costs and improve the delivery systems.
10. Promote equitable investment in water infrastructure.

Water Infrastructure Strategies

1. Promote water efficiency for new water infrastructure projects.
2. Provide funding for water treatment systems.
3. Provide funding for water conveyance systems and storage systems, such as diversion structures for agricultural systems, tanks, and lift stations for public water systems, and/or Underground Storage and Recovery (USR).
4. Support funding for infrastructure to support reuse of wastewater where appropriate.
5. Provide funding for wastewater treatment systems.
6. Provide funding for the Ute Reservoir Pipeline Project, which is critical to providing supply to alleviate the projected deficit for public water systems (PWSs) serving Clovis, Cannon Air Force Base, Portales, Elida, Melrose, Grady, Tucumcari, and Logan (see *Part II: Technical Report,* Section 3.3).
7. Provide support for regionalized or expanded water systems where appropriate and consistent with the desires and customs of local communities to combine small water systems or domestic wells.
8. Support agricultural infrastructure that reduces water loss where seepage is not the source of supply for downstream users.
9. Provide funding to support dam repairs and maintenance, particularly for the dams identified in *Part II: Technical Report,* Section 6.6, with high or significant hazard potential in poor condition.
10. Provide necessary funding and staff for state, federal, and tribal inspections of dams.
11. Provide funding for planning and design to improve resilience of stormwater systems.
12. Assist communities and irrigation districts in developing appropriate rate structures or other funding mechanisms to fund infrastructure projects and operations and maintenance.
13. Seek state or local matching dollars to capitalize on federal funding for water infrastructure projects that require a match.
14. Work with water users to develop strategies to manage earlier runoff.
15. Develop priorities for funding infrastructure that considers, at a minimum, life-cycle costs, equity, and ecosystem impacts, and provides sufficient funding to complete projects.

The state of New Mexico has significant water infrastructure repair and improvement needs. Communities in eastern New Mexico need to build the Ute Pipeline to reduce dependence on the declining High Plains aquifer and to supplement concurrent strategies for sustaining this aquifer.

These infrastructure needs should be conveyed at the federal level to maximize federal matching funds while efficiently utilizing limited available local funding. Funding agencies will need to continue to develop priorities for funding infrastructure in ways which consider life-cycle costs and appropriateness, while providing sufficient funding to complete projects.

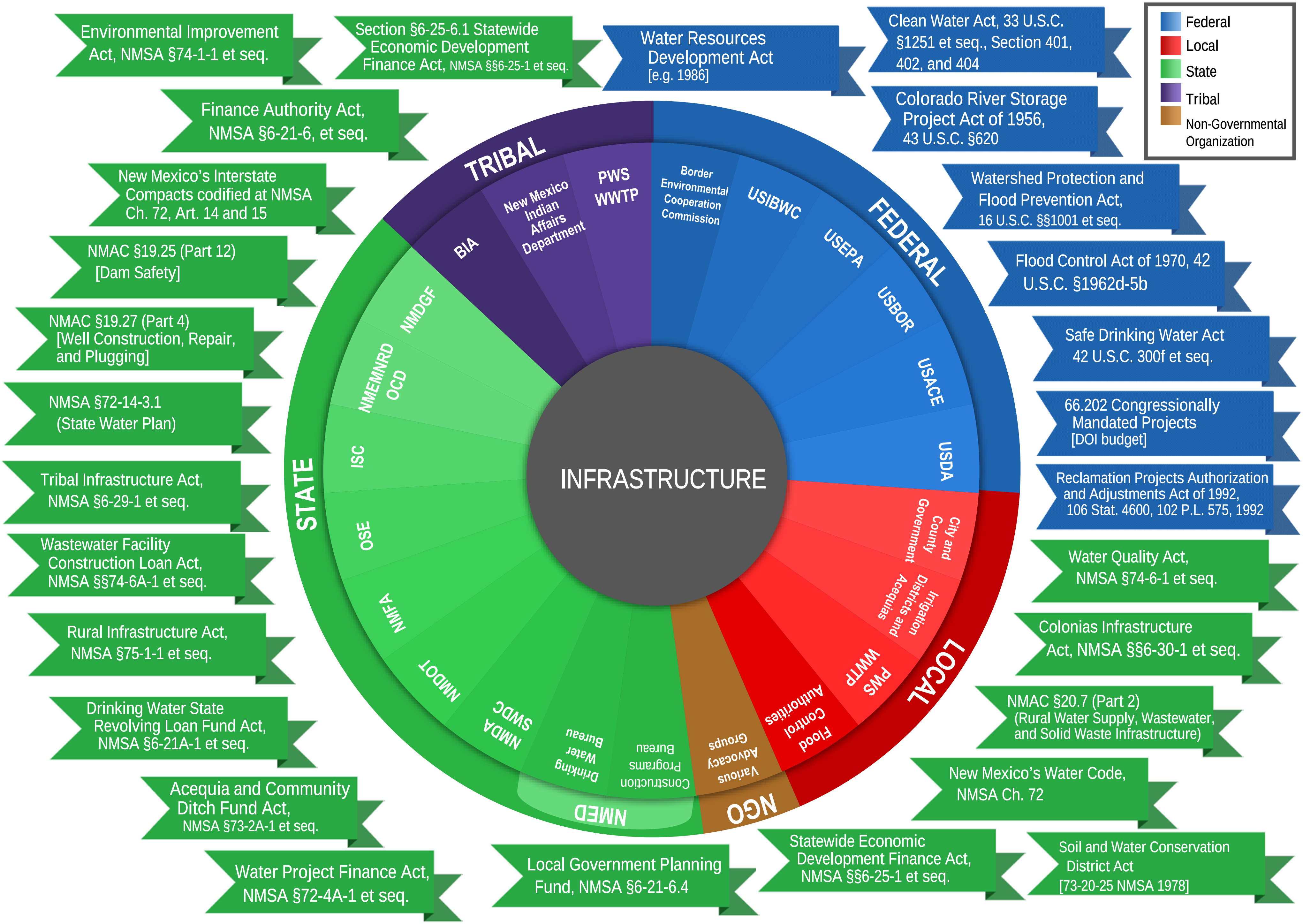

Figure 1. Statutes and Organizations Related to Infrastructure

Table 1. Directory of Organizations Crucial to Providing Support and Oversight of Infrastructure

Infrastructure Type	Funding	Support, Construction, and/or Regulatory Oversight
Public Water Systems	US Bureau of Reclamation WaterSMART Programs ▪ Title XI Water Reclamation and Reuse Program ▪ Water and Energy Efficiency Grants ▪ Water Marketing Strategy Grants	US Bureau of Reclamation ▪ Manages, develops, and protects water projects and facilities
	NM Environment Department Construction Programs Bureau ▪ Rural Infrastructure Revolving Fund (mutual domestics and small communities or counties)	NM Environment Department Construction Programs Bureau ▪ Administers capital outlay of public water system projects funded by legislature NM Office of the State Engineer ▪ Water Rights Division (well permitting) ▪ Underground Storage and Recovery NM Rural Water Association
	NM Environment Department Drinking Water Bureau ▪ Drinking Water State Revolving Loan Fund (co-managed with New Mexico Finance Authority)	NM Environment Department Drinking Water Bureau ▪ Samples public water systems to ensure safety of water quality ▪ Provides board and operator training ▪ Conducts water and sewer rate surveys ▪ Regulatory oversight of public water systems ▪ Technical, managerial, and financial assistance for public water systems NM Environment Department Surface Water Quality Bureau ▪ Supports US Environmental Protection Agency in Point Source Regulation (wastewater discharge to surface water) (New Mexico does not have primacy for National Pollution Discharge Elimination System permitting) US Environmental Protection Agency
	NM Finance Authority ▪ Drinking Water State Revolving Loan Fund (co-managed with NM Drinking Water Bureau) ▪ Colonias Infrastructure Project Fund ▪ Public Project Revolving Fund ▪ Local Government Planning Fund ▪ Water Trust Board Water Project Fund	NM Interstate Stream Commission ▪ Arizona Water Settlement Act for non-NM Unit projects NM Water Infrastructure Team Colonias Infrastructure Board Legislative Oversight Committee Water Trust Board NM Finance Authority Board
	US Army Corps of Engineers ▪ Water Infrastructure Finance and Innovation Act provides incentives through low-cost federal loans	US Army Corps of Engineers ▪ Builds and maintains infrastructure for civil works (water supply, regulatory) ▪ Contingency operations (critical infrastructure)
	US Department of Agriculture Rural Development ▪ Water and Waste Disposal Loan and Grant Program	US Department of Agriculture Rural Development
	NM Rural Community Assistance Corporation ▪ Environmental Infrastructure Loan Program	Rural Community Assistance Corporation ▪ Training and technical assistance to water and wastewater systems
	Border Environment Cooperation Commission ▪ Project Development Assistance Program (water and wastewater)	Border Environment Cooperation Commission ▪ Administers Border 2020 Program (improve access to clean and safe water and waste management)

Table 1. Directory of Organizations Crucial to Providing Support and Oversight of Infrastructure (Continued)

Infrastructure Type	Funding	Support, Construction, and/or Regulatory Oversight
Public Wastewater Systems	NM Environment Department Construction Programs Bureau ▪ Clean Water State Revolving Fund (wastewater, stormwater, and non-point source) ▪ Rural Infrastructure Revolving Fund (mutual domestics and small communities or counties)	NM Environment Department Ground Water Quality Bureau ▪ Groundwater Discharge Plans (wastewater discharge to groundwater)
		NM Environment Department Construction Programs Bureau ▪ Administer capital outlay of public wastewater system projects funded by legislature
		NM Environment Department Surface Water Quality Bureau ▪ Supports US Environmental Protection Agency in point source regulation (wastewater discharge to surface water) (New Mexico does not have primacy for NPDES permitting)
	NM Finance Authority ▪ Colonias Infrastructure Project Fund ▪ Public Project Revolving Fund ▪ Local Government Planning Fund ▪ Water Trust Board funds	Colonias Infrastructure Board
		NM Finance Authority Board
		Legislative Oversight Committee
	US Environmental Protection Agency ▪ Funding of State programs	US Environmental Protection Agency ▪ Point source regulation (wastewater discharge to surface water)
	US Department of Agriculture Rural Development ▪ Water and Waste Disposal Loan guarantees	US Department of Agriculture Rural Development
	Border Environment Cooperation Commission ▪ Project Development Assistance Program (water and wastewater)	Border Environment Cooperation Commission ▪ Administers Border 2020 Program (improve access to clean and safe water, waste management)
	Rural Community Assistance Corporation ▪ Environmental Infrastructure Loan Program	Rural Community Assistance Corporation ▪ Training and technical assistance to water and wastewater systems
Tribal Water Systems	NM Indian Affairs Department ▪ Tribal Infrastructure Fund	NM Indian Affairs Department
	Bureau of Indian Affairs ▪ 638 Contracts	Bureau of Indian Affairs
		US Army Corps of Engineers ▪ Tribal Nations Program (consults with tribes that may be affected by US Army Corps of Engineers projects/ policies, partner with tribes on water resources)
		US Bureau of Reclamation ▪ Regional-scale water supply projects

Table 1. Directory of Organizations Crucial to Providing Support and Oversight of Infrastructure (Continued)

Infrastructure Type	Funding	Support, Construction, and/or Regulatory Oversight
Tribal Wastewater Systems	US Environmental Protection Agency ▪ Funding of tribal programs	US Environmental Protection Agency ▪ National Pollution Discharge Elimination System permits
	Bureau of Indian Affairs ▪ 638 Contracts	Bureau of Indian Affairs
	NM Indian Affairs Department ▪ Tribal Infrastructure Fund	NM Indian Affairs Department
Agricultural Water Systems	NM Department of Agriculture ▪ Agricultural Programs and Resources ▪ Water Quality and Conservation Grant ▪ Regional Conservation Partnership Program	NM Department of Agriculture
	NM Finance Authority ▪ Public Project Revolving Fund ▪ Local Government Planning Fund ▪ Water Trust Board Water Project Fund	NM Finance Authority Legislative Oversight Committee NM Finance Authority Board Water Trust Board
	US Bureau of Reclamation ▪ Irrigation projects	US Bureau of Reclamation
	US Army Corps of Engineers	US Army Corps of Engineers
	US Department of Agriculture Natural Resources Conservation Service ▪ Agricultural Management Assistance ▪ Conservation Stewardship Program ▪ Environmental Quality Incentives Program ▪ The Water Bank Program ▪ New Mexico Department of Agriculture ▪ Soil and Water Conservation Districts	United States Department of Agriculture Natural Resources Conservation Service ▪ Technical Assistance ▪ Regional Conservation Partnership Program ▪ Conservation Reserve Program
	NM Interstate Stream Commission ▪ Acequias Rehabilitation Grant Program-administer Capital Outlay and Irrigation Works Construction Fund ▪ Arizona Water Settlement Act-NM Unit and Non-Unit Irrigation Projects	NM Interstate Stream Commission Acequia Program ▪ New Mexico Acequia Association ▪ New Mexico Association of Conservation Districts
Tribal Irrigation Systems	Bureau of Indian Affairs Office of Trust Services ▪ Indian Irrigation Projects	Bureau of Indian Affairs ▪ Office of Trust Services ▪ Water Resources Offices US Army Corps of Engineers ▪ Tribal Nations Program (consult with tribes that may be affected by US Army Corps of Engineers projects/ policies, partner with tribes on water resources)
	US Bureau of Reclamation ▪ Irrigation Projects	US Bureau of Reclamation

Table 1. Directory of Organizations Crucial to Providing Support and Oversight of Infrastructure (Continued)

Infrastructure Type	Funding	Support, Construction, and/or Regulatory Oversight
Stormwater Infrastructure	NM Environment Department Surface Water Quality Bureau ▪ Nonpoint Source Management Program ▪ River Stewardship program NM Environment Department Construction Programs Bureau ▪ Clean Water State Revolving Fund (stormwater and non-point source)	NM Environment Department Surface Water Quality Bureau US Environmental Protection Agency ▪ Issues Municipal Separate Storm Sewer Systems (MS4) Permits Flood Control Authorities and Commissions ▪ Albuquerque Metropolitan Arroyo Flood Control Authority ▪ Southern Sandoval County Flood Control Authority ▪ Eastern Sandoval County Arroyo Flood Control Authority ▪ Dona Ana County Flood Commission NM Department of Transportation ▪ Manages non-point source discharges from roads ▪ Manages stormwater discharges from roads
	US Army Corps of Engineers ▪ Federal Energy and Water Development Appropriations Act Funds (dependent on federal budget)	US Army Corps of Engineers ▪ Builds and maintain infrastructure for civil works (flood control, disaster response, regulatory) ▪ Develops contingency operations (disaster response and recovery, life-cycle flood risk management, critical infrastructure) International Boundary and Water Commission ▪ Builds and maintains infrastructure for flood control on the Rio Grande downstream of Percha diversion dam (the Rio Grande Canalization Project)
Reservoirs	NM Finance Authority ▪ Public Project Revolving Fund ▪ Local Government Planning Fund ▪ Water Trust Board funds	NM Office of the State Engineer ▪ Manages water rights ▪ Reviews and approves construction of new dams, modifications to existing dams, and conducts inspections of existing dams to ensure safety
	NM Office of the State Engineer ▪ Administer Capital outlay funding	NM Department of Game & Fish ▪ Operates and maintains dams ▪ Operates and maintains irrigation infrastructure
	US Bureau of Reclamation ▪ Water and Energy Efficiency grants	US Bureau of Reclamation ▪ Manages, develops, and protects water projects and facilities, including owning and operating several dams
	US Department of Agriculture Natural Resources Conservation Service ▪ Farm Bill ▪ New Mexico Department of Agriculture ▪ Soil and Water Conservation Districts	US Department of Agriculture Natural Resources Conservation Service ▪ Rehabilitation of dams ▪ Emergency action plans NM Interstate Stream Commission ▪ Conducts responsibilities related to compact compliance ▪ Manages reservoirs
	US Army Corps of Engineers ▪ Civil Works Program Budget	US Army Corps of Engineers ▪ Builds and maintains infrastructure of civil works (flood control, water supply, regulatory)

2. Data Collection, Accessibility, and Monitoring Policy

Data collection, accessibility, and monitoring rose to the top in many of the 2016-2017 Regional Water Plan lists of PPPs and recommendations to the state; as well as in lists generated during the 2017 New Mexico State Water Plan Town Hall event (NMF, 2018).

Steering committee members raised concerns about the need for more information on water resources, the need to standardize data collection and storage (in databases), and the need to share data among stakeholders. Additionally, the state would benefit from improved coordination with water management agencies and stakeholders to better understand the state's water resources.

Data collection, accessibility, and monitoring is clearly spelled out in the State Water Plan Act (NMSA §72-14-3.1 (C)(2)) and the *2003 New Mexico State Water Plan,* which states that "the state water plan shall establish a clear vision and policy direction for active management of the state's waters."

PHOTO 2. REPLOGLE FLUME.
PHOTO CREDIT: AMY C. LEWIS

The *2003 New Mexico State Water Plan* includes a policy statement in response to this directive that "the State shall accurately measure its water users and inventory the quantity and quality of its water supply." One of the strategies for this policy statement is to use tools for "real-time measuring and metering of all water use…" The next section, NMSA §72-14-3.1 (C)(3), also addresses data collection: "include an inventory of the quantity and quality of the state's water resources," as well as NMSA §72-14-3.1 (C)(4): "include water budgets for the state and for all major river basins and aquifer systems in the state." NMSA §72-14-3.1 (D)(2) calls for the "creation and completion of a comprehensive database and an electronically accessible information system on the state's water resources and water rights, including file abstraction and imaging of paper files as well as information on pending adjudications" ; NMSA §72-14-3.1 (D)(3) describes "measuring of surface and ground water uses in the state as necessary for management of the state's water resources." Each of these policy statements recommended measuring, metering, and monitoring our water supply.

Data collection of basic information for analysis of water supply, such as snowpack and precipitation, water diversions (including fresh, brackish, and saline water), return flow, irrigated acreage, aquifer thickness, extent and capacity, water levels, and water quality, are fundamental to managing New Mexico water resources. The recommendation from the regional water plans and other stakeholders is not only to develop a central clearing house for data access, but also to fill in the gaps where monitoring, water use metering, and hydrogeologic information are lacking (see *Part II: Technical Report,* Section 6.4).

Table 2 provides information about some of the critical government agencies responsible for statewide or national data collection and the types of data collected. Any strategy to collect, compile, and provide access to data must be mindful of sensitive issues with regard to sovereign tribes and pueblos.

This list does not include the many cities, counties, tribes, industries, and non-governmental organizations (NGOs) that also collect valuable water supply and water quality data. Some data collection is historic and ongoing, such as stream flow or water level monitoring at specific sites and lends itself to consolidation in a central database. Other types of data collection are more challenging to incorporate into a centralized form. For example, project-specific data (such as a geophysical investigation or photographic documentation of changes in bank erosion before and after riparian restoration efforts) will not conform to a database containing specific measurements.

Some data are in hard copy form, such as metered use of treated effluent that is submitted pursuant to a groundwater discharge permit. Other data are contained in reports, spreadsheets, and databases on individual government computers. Some data are accessible via the internet, such as the United States Geological Survey (USGS) National Water Information System (NWIS); or the National Oceanic and Atmospheric Administration (NOAA) Climate page, which contains monitoring data; the United States Environmental Protection Agency (USEPA) STOrage and RETrieval (STORET) database for water quality data, or the New Mexico Office of the State Engineer (OSE) Water Rights Reporting System (NMWRRS, also referred to as the OSE WATERS Database), which contains water diversion and water rights information. As part of Active Water Resources Management (AWRM) the OSE/ISC website includes real-time water measurement information for surface water diversions and includes all the data required for each interstate compact (OSE, 2018).

The end goals for this data collection policy are ambitious. Coordinating among agencies to not only maximize and share resources, but also identify the purposes for which data is collected, sources of funding, data collection needs for the planning regions and the state, the gaps in data collection, and to explore methods to create a clearing house for data is a significant undertaking and would require leadership and staff resources that may not be currently available. However, many agencies are collecting and making data more accessible at the rate possible.

As Figure 2 and Table 2 show, many agencies are providing information, cooperation, and access to data in free and open-source formats. Encouraging this style of data sharing will only benefit future water planning efforts but note that future efforts will be made easier if data collection protocols and database formats are standardized.

Data Collection, Accessibility, and Monitoring Goals

1. Improve management of water resources and protect senior water-right holders.
2. Identify new sources of supply, including brackish and saline water resources and produced water.
3. Continually improve groundwater and surface water models to better estimate impacts on streams and aquifers from groundwater pumping, water rights, compact deliveries, lifetime of aquifers, and water quality.
4. Protect human health and natural resources.
5. Promote accessibility to data.

Data Collection, Accessibility, and Monitoring Strategies

1. Develop means for coordination between agencies and productive data-sharing methods.
2. Require metering of water use in the state, which will require legislative support and collaboration with the State Engineer and water users. This endeavor will require particular care in working with the agricultural water use category to meter diversions and irrigation return flows.
3. Expand the capacity of NMWRRS database or other database systems as needed to store water right and water use information throughout the state.
4. Create a statewide water right owner interface for entering meter data.
5. Expand aquifer mapping to better identify the extent of all water resources (including brackish and saline water) and better define aquifer boundaries for improved groundwater-surface water modeling.
6. Identify areas that require increased groundwater level monitoring, stream flow measurements, and water quality assessment, and seek funding to expand these networks.

7. Support continued enhanced estimates of agricultural surface water use by OSE through stream flow monitoring, geographic information system (GIS) techniques, evaporation and evapotranspiration studies, and other methods.
8. Update Federal Emergency Management Agency (FEMA) flood plain maps based on forecast climate conditions, and identify areas, bridges, and culverts that require more protection from projected increases in intensity of precipitation.
9. Support further research for quantifying the impact of vegetation management and wildfire on water resources.
10. Identify gaps of standardized data collection protocols and procedures for New Mexico related to water and prioritize efforts to address these gaps.
11. Develop a process or agency to be responsible for integrating numerous existing data sources where applicable.
12. Improve collection and communication of data for changes of water use to oil and gas purposes
13. Collect data on reusable water (municipal wastewater, produced water, industrial wastewater), to evaluate effect on savings for fresh water.
14. Collect data on production costs and unit prices of produced water in addition to information on quality and quantity.
15. Increase forest mapping, such as forest density, to help prioritize watershed management projects
16. Explore possibility of appointing a watermaster in each declared surface water basin.
17. Support the expanded collection of habitat data as needed to protect threatened and endangered species.

In summary, the state of New Mexico's data collection, accessibility, and monitoring priorities are vast and complex and will require coordination with local, tribal, state, and federal agencies and stakeholders to define data needs (i.e. precipitation, stream flow, groundwater level, and water quality monitoring) and improve measurement and estimates of water diversions, depletions, and return flows, and revise groundwater-surface models. Support is needed for OSE to expand the existing database for tracking water right and water use data and create a centralized platform for managing measured or metered water diversions.

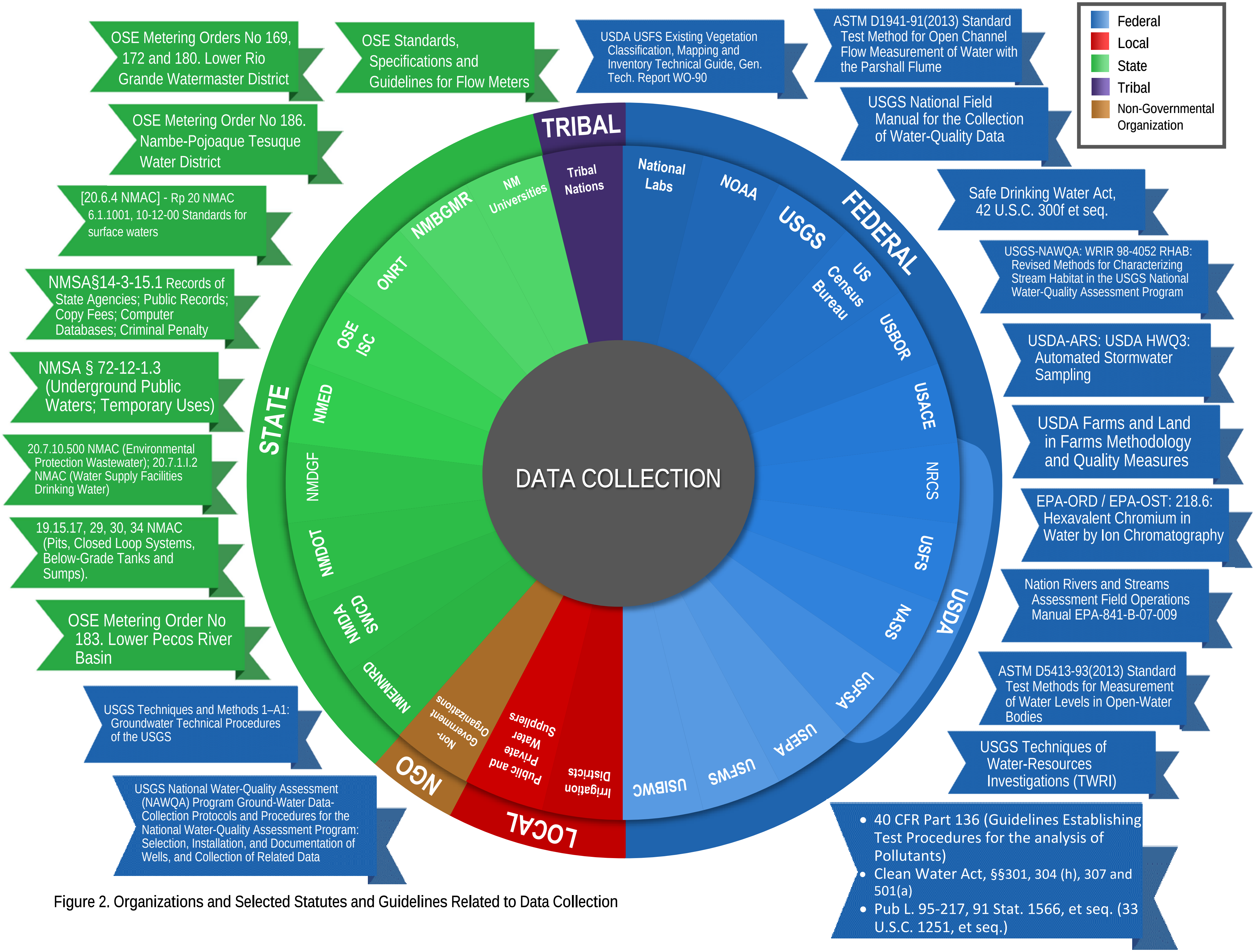

Figure 2. Organizations and Selected Statutes and Guidelines Related to Data Collection

Table 2. Directory of Major Organizations Involved in Water Data Collection

	Precipitation (Including snowpack)	Stream Flow	Soil Moisture	Water Levels	Water Quality	Aquifer Parameters	Evaporation/Evapotranspiration	Biological Parameters	Groundwater Modeling	Surface Water Modeling	Aquifer Mapping	Geologic Information	Population	Water Diversions	Water Rights Information	Agricultural (Acreage/Crop & Livestock Inventories)	Reservoir Levels	Dam Condition	Fuel Moisture	Fire Intensity/Extent	Vegetation Surveys	Landscape Treatments	Contaminant Sources	Wastewater Volume Reused	Treated Wastewater Quality	Volume of Produced Water
Federal Agencies																										
US Geological Survey	X	X	X	X	X	X	X	X	X	X	X	X		X			X	X								
US Army Corps of Engineers	X	X	X	X	X			X		X							X	X								
US Bureau of Reclamation		X								X							X	X								
US Environmental Protection Agency					X																					
US Census Bureau													X													
NOAA National Climatic Data Center	X		X																							
US Fish and Wildlife								X																		
International Boundary and Water Commission		X																								
US Department of Agriculture																										
National Agricultural Statistics Service (NASS) and USFSA																X										
Natural Resources Conservation Service (NRCS)	X		X																		X	X				
Forest Service (USFS)	X	X	X	X	X			X									X		X	X	X					
National Labs																										
Sandia National Laboratories				X	X				X																	
Los Alamos National Laboratories				X	X				X																	
Waste Isolation Pilot Plant (WIPP)				X	X				X																	
State Agencies																										
NM Department of Health Scientific Laboratory Division					X																					
NM Bureau of Geology and Mineral Resources	X	X	X	X	X	X	X		X	X	X	X									X					
NM Department of Agriculture and Soil and Water Conservation Districts (SWCDs)				x												X		X			X	X				
NM Department of Game & Fish				X	X			X							X		X	X			X	X	X			
New Mexico Environment Department																										
Ground Water Quality Bureau				X	X	X																	X	X		
Surface Water Quality Bureau		X			X			X															X	X	X	
Drinking Water Bureau					X																		X			
Solid Waste Bureau				X	X																		X			
Petroleum Storage Tank Bureau				X	X	X																	X			
Hazardous Waste Bureau				X	X	X																	X			
Department of Energy Oversight Bureau	X	X	X	X	X	X		X	X	X	X												X			

Table 2. Directory of Major Organizations Involved in Water Data Collection (Continued)

	Precipitation	Stream Flow	Soil Moisture	Water Levels	Water Quality	Aquifer Parameters	Evaporation/Evapotranspiration	Biological Parameters	Groundwater Modeling	Surface Water Modeling	Aquifer Mapping	Geologic Information	Population	Water Diversions	Water Rights Information	Agricultural Acreage/Crop and Livestock Inventories	Reservoir Levels	Dam Condition	Fuel Moisture	Fire Intensity/Extent	Vegetation Surveys	Landscape Treatments	Contaminant Sources	Wastewater Volume Reused	Treated Wastewater Quality	Volume of Produced Water
NM Office of the State Engineer																										
Dam Safety Bureau																		X								
Hydrographic Survey Bureau														X	X	X										
Water Use and Conservation Bureau							X							X		X										
Water Rights Bureau												X		X	X											
Hydrology Bureau				X		X	X		X	X	X	X														
District Offices		X												X												
Water Masters		X												X												
NM Interstate Stream Commission		X		X	X	X	X	X	X	X	X			X			X									
NM Energy and Minerals Natural Resources Department																										
Oil Conservation Division					X																		X			X
Mining and Minerals Division	X			X	X																X		X			
State Forestry Division																				X	X	X				
State Universities																										
University of NM																										
Bureau of Business & Economic Research													X													
Department of Earth and Planetary Sciences											X	X														
New Mexico Institute of Mining and Technology																										
Earth and Environmental Sciences					X	X	X		X	X	X	X														
Petroleum Recovery Resource Center																										X
NM State																										
Water Resources Research Institute					X		X		X					X		X										
NM Climate Center	X																									
NM Highlands University																										
Forest and Watershed Restoration Institute																				X		X				

3. Drought Policy

The State Water Plan Act at NMSA §72-14-3.1 (C)(6) states that the plan should "include a drought management plan designed to address drought emergencies, promote strategies for prevention of drought-related emergencies in the future and coordinate drought planning statewide." The State of New Mexico Drought Task Force is dedicated to preparing and updating the state's drought plan.

PHOTO 3. CORN SHOWING EFFECTS OF DROUGHT.
PHOTO CREDIT: BOB NICHOLS, USDA. PUBLIC DOMAIN

Drought is challenging to define because it is not a distinct event with a beginning and end and is only recognizable after a period of time. Drought and water supply are intertwined but not always directly related. For example, a meteorological drought in one location may not result in a water supply shortage to all water users in that location, depending on where the source of supply is located.

Drought challenges the reliability of water supplies and increases the likelihood of water shortages for many users. The wide-ranging characteristics of drought affects both water quantity and quality, such as reduced stream flow, groundwater recharge, reductions in grass or hay for rangeland animals, and exceedances of temperatures for cold-water fisheries. The shortages of surface water for farmers, public water systems, and ecosystems were the subject of the key water issues for most planning regions (described in *Part II: Technical Report,* Section 6.2) and the subject of key collaborative strategies and PPPs (*Part II: Technical Report,* Section 7).

Some of the fundamental components of managing for drought include monitoring, assessing risk based on numerous indicators of drought, mitigating, and responding to drought. Preparation for drought to minimize harm to the state's economy, environment, and residents is an essential component of water planning, along with collaboration and adaptive management.

Many of the strategies in the Water Conservation Policy can be applied during drought, depending on the degree of "demand hardening" that has occurred within a water system. Demand hardening refers to the reduced flexibility of a water system to achieve increasingly greater reductions in per capita water use in response to additional conservation measures. Droughts are episodic, widespread events, and as a result, most of the 2016-2017 Regional Water Plan updates identified drought mitigation as a key water issue. Figure 3 presents agencies and institutions involved in monitoring drought information, assessing risk, preparing for, and/or responding to drought. Table 3 is a directory of the numerous federal, state, and local resources which support drought information tracking, planning, and response in New Mexico.

Drought Policy Goals

1. Continue to update the New Mexico Drought Plan in response to changing conditions.
2. Continue to support the New Mexico Governor's Drought Task Force to continue to assess current conditions, create short- and long-term strategies, and provide information.
3. Forecast drought conditions.

4. Ensure sufficient water to meet basic needs for human health.
5. Protect sensitive species and habitat during drought.
6. Protect the economy during drought.

Drought Strategies

1. Support and expand drought mitigation and response planning efforts at the local, regional, basin, state, and federal level. Data collection, accessibility and monitoring suggested under Policy 2 will be necessary to help develop the predictive models for preparing for future climate conditions. Conservation strategies in Policy 6 should be included in a drought response, but communities must be aware of "demand hardening," which reduces the flexibility of public waters systems to adapt to drought.
2. Communities need to prepare for drought by developing a conjunctive use portfolio, such as those developed by the cities of Albuquerque and Santa Fe, whereby surface water is relied on during wet years and groundwater is reserved for drought periods.
3. Alternative water supplies should also be explored, such as treated effluent reuse, desalination of brine or saline resources that are not hydrologically connected to fresh water resources.
4. Monitor drought conditions and support the US Drought Monitor, Natural Resource Conservation Service (NRCS) Snow Telemetry (SNOTEL) Sites, USGS stream flow, various agencies' groundwater level monitoring; and other data collection, such as the New Mexico Energy, Minerals, and Natural Resources Department (NMEMNRD) Oil Conservation District (OCD) collection of produced water and dissemination efforts.
5. Support and encourage shortage sharing agreements. Provide technical and institutional support, such as facilitation, for water sharing with data and tools that can be used by stakeholders, such as acequias, tribal governments, and local governments, to develop and implement shortage sharing agreements.
6. Prepare for earlier snowmelt runoff; each region should assess the impact on availability of surface water supplies, particularly where storage of surface water is not an option.
7. Assess threats to the water supply, endangered species, and the economy caused by drought and create and implement mitigation strategies.
8. Support effective coordination among local, state, tribal, and federal agencies responsible for managing water supply, water quality, fisheries, and drought and water forecasting.
9. Support the development of drought triggers or other indicators to create drought response.
10. Support the National Guard, Department of Homeland Security and Emergency Management (DHSEM), and other entities in providing emergency response during drought.
11. Promote the use of water banks to provide flexibility for managing water use and allocation, particularly during drought.
12. Collaborate with the United States Forest Service (USFS) to better understand what can and should be done to protect water storage and delivery from National Forest Service lands under changing climatic conditions.

In summary, the state of New Mexico's needs to continue to monitor and assess drought conditions and promote the development of drought mitigation through a coordinated drought response by local, state and tribal agencies in the state. Key strategies for drought plans should include mechanisms to reduce demand, the development of conjunctive-use water supply portfolios (where possible), shortage sharing agreements to reduce conflict during periods of drought and explore alternatives such as desalination to meet future needs during periods of drought where other options may not be available.

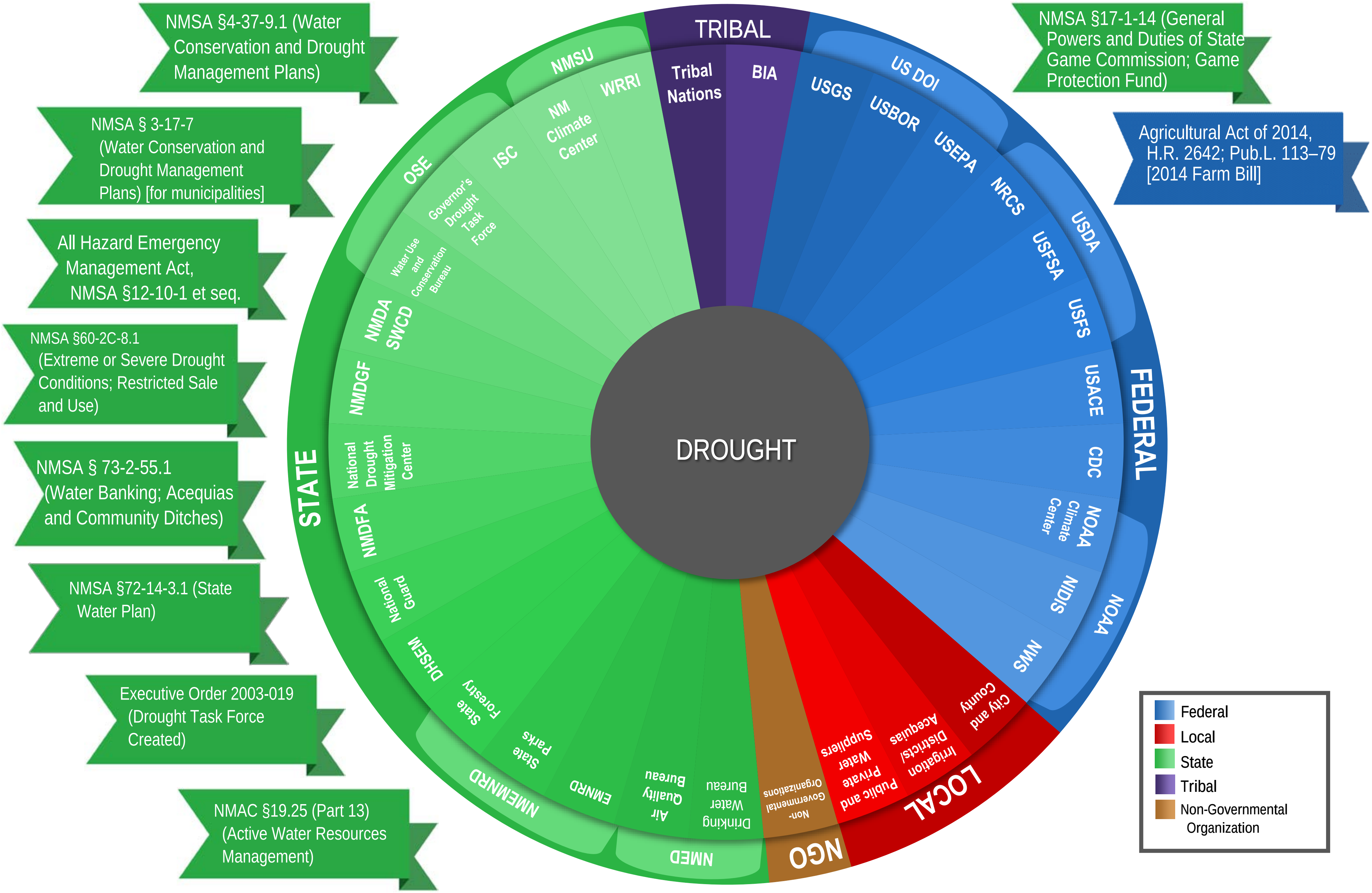

Figure 3. Acts and Organizations Related to Drought Planning and Response

Table 3. Directory of Organizations Related to Drought Planning and Response

Type of Organization	Organizations
Federal	US Department of the Interior United States Geological Survey ▪ Water Watch Program, drought data, and maps ▪ Southwest Geographic Science Team: drought impact monitoring US Bureau of Reclamation ▪ WaterSMART ▪ Drought Response Program ▪ Drought Contingency Planning Program ▪ Drought Resiliency Program ▪ Emergency response programs ▪ Basin studies US Environmental Protection Agency ▪ Drought resilience and water conservation ▪ Drought and WaterSense
	National Drought Mitigation Center ▪ Conduct drought research ▪ Drought monitoring resources ▪ Drought impact reporter ▪ Drought planning information ▪ Drought forecasting ▪ NM State drought planning
	US Center for Disease Control ▪ Drought and health
	United States Army Corps of Engineers ▪ Temporary emergency water assistance for human consumption ▪ Supplements state and local efforts
	US Department of Agriculture Natural Resources Conservation Service and Soil and Water Conservation Districts ▪ National Water and Climate Center ▪ Disaster Recovery Assistance ▪ Emergency Watershed Protection ▪ Defending Against Drought
	US Department of Agriculture Farm Service Agency, New Mexico National Agricultural Statistics Service ▪ Annual Statistical Bulletin ▪ Crop progress and condition ▪ Emergency conservation programs
	US Department of Agriculture Forest Service ▪ Climate Change Resource Center ▪ Manage wildland fire on National Forests and Grasslands ▪ National Forests and Grasslands implement drought guideline for grazing permit administration ▪ Pacific Southwest Research Station ▪ Rocky Mountain Research Station

Table 3. Directory of Organizations Related to Drought Planning and Response (Continued)

Type of Organization	Organizations
Federal	National Oceanic and Atmospheric Administration Climate Center for Environmental Information ▪ State of Climate reports ▪ Historical Palmer Drought Indices ▪ Temperature, precipitation, and drought data National Integrated Drought Information System ▪ US Drought Portal: includes US Drought Monitor, US Seasonal Drought Outlook, Drought Impacts Report, Wildfire Risk, and Snow Drought National Weather Service ▪ Red flag warnings ▪ Forecasting
State	New Mexico Fire Restrictions on Federal, State and Tribal Land ▪ Fire restrictions and forest closures
	NM Office of the State Engineer Water Use and Conservation Bureau ▪ Drought information ▪ NM Water Conservation Planning Guide for Public Water Suppliers
	New Mexico Bureau of Geology and Mineral Resources ▪ Groundwater monitoring and aquifer mapping
	New Mexico Governor's Drought Task Force ▪ New Mexico Drought Plan 2006
	NM Interstate Stream Commission ▪ Interstate compact activities ▪ Support development of shortage sharing agreements ▪ Regional and state water planning ▪ Endangered Species Act compliance
	NM Department of Homeland Security and Emergency Management ▪ Information about preparing for and responding to emergencies
	New Mexico National Guard ▪ Temporary water source in emergencies
	NM Environment Department Drinking Water Bureau ▪ Community and technical assistance related to drought planning ▪ Emergency Response Plan ▪ Drinking Water Watch Database ▪ Source Water Protection Program ▪ Drought information Air Quality Bureau ▪ Air quality and monitoring data ▪ Smoke Management Program Construction Programs Bureau ▪ Grant and loan programs for water planning and infrastructure

Table 3. Directory of Organizations Related to Drought Planning and Response (Continued)

Type of Organization	Organizations
State	New Mexico Energy, Minerals and Natural Resources Department ▪ New Mexico State Parks, fire restrictions New Mexico State Forestry ▪ Fire restrictions ▪ Forest Health Conditions Report
State	New Mexico Department of Game & Fish ▪ Wildlife and Sportfish Management ▪ Emergency Hunting Prohibition
State	NM State University, New Mexico Water Resources Research Institute ▪ Statewide Water Assessment ▪ Climate center New Mexico Department of Agriculture ▪ Soil and Water Conservation Districts
State	New Mexico Department of Finance and Administration ▪ Community Development Bureau: Water and Drought Information ▪ Guidebook for Small Water Systems
State	New Mexico State Fire Marshall's Office ▪ Allow municipalities to restrict sale and use during drought
State	New Mexico Fire Information ▪ Fire and fire restriction updates
Tribal	Bureau of Indian Affairs ▪ Planning and management of water resources
Non-Government Organizations	New Mexico Rural Community Assistance Corporation ▪ Drought resources ▪ Tribal source water protection
Non-Government Organizations	New Mexico Rural Water Association ▪ NM Water/ Wastewater Response Network ▪ Source Water Protection Program

4. Watershed Management Policy

Watershed management includes activities such as restoration of degraded uplands to increase soil health, thinning dense forests to reduce the threat of catastrophic wildfire and subsequent debris flows, and improving the resilience of riparian areas to reduce erosion, store water, and improve habitat. Watershed management also involves management of wildlife and livestock and urban stormwater management.

PHOTO 4. TRAMPAS LAKE
PHOTO CREDIT: STEVE CARY

The State Water Plan Act at NMSA §72-14-3.1 (C)(8)) states that the plan shall "promote river riparian and watershed restoration that focuses on protecting the water supply, improving water quality and complying with federal Endangered Species Act of 1973 [16 U.S.C. § 1531 et seq.] mandates."

Watershed management is of paramount concern, particularly for communities dependent on surface water (see *Part II: Technical Report*, Section 6.3). The 2016-2017 Regional Water Plan updates (ISC, 2016-2017) included recommendations for multiple projects to address riparian and forest restoration (*Part II: Technical Report*, Section 7); and the 2017 New Mexico State Water Plan Town Hall event also produced many recommendations for watershed management (NMF, 2018).

New Mexico's Soil and Water Conservation Districts were formed, in part, for the purpose of controlling and preventing soil erosion, preventing floodwater and sediment damage, and ultimately conserving and developing the natural resources of the state; thus, Soil and Water Conservation Districts have authority to implement watershed restoration. The Southwest Forest Health and Wildfire Prevention Act of 2004 (Public Law 108–317 108th Congress), which was established to reduce the risk of wildfires and restore the health of fire-adapted forests and woodland ecosystems in the interior American West, further demonstrates the importance of this policy topic.

The USFS developed a Watershed Condition Framework (USFS, 2011) that can serve as a template for moving the state forward in characterizing the condition of watersheds and prioritizing the restoration activities. In 2005, NMSA 1978 § 72-14-3.3 gave the ISC the authority to establish the strategic water reserve to purchase or lease water or water rights to comply with interstate stream compacts and court decrees, and also to assist the state and water users in water management efforts for the benefit of threatened or endangered species. To date, a total of 2,748 acre-feet (ac-ft) of water rights have been acquired by ISC on the Middle Rio Grande and Pecos River and placed into the reserve.

Figure 4 shows various organizations involved in watershed management throughout the state, as well as the supporting statutes and rules. Over 30% of New Mexico's land and more than 50% of New Mexico's perennial stream miles are managed by the USFS and the United States Bureau of Land Management (USBLM). For this reason, these agencies play an essential role in watershed management (NMED, 2018). Table 4 is a directory of the critical government agencies that fund and support forest restoration, riparian restoration, and stormwater management.

Watershed Management Goals

1. Reduce the risk of catastrophic wildfire.
2. Reduce intensity of runoff from flood flows.
3. Reduce erosion and stream incision; protect adjacent groundwater.
4. Restore or maintain hydrology to enhance floodplain connection and dissipation of flood energy associated with overbank flows and improve ecosystem benefits such as instream flows.
5. Restore or maintain riparian areas and wetlands to more effectively filter pollutants and provide water during dry seasons and prolonged drought.
6. Enhance the economic benefits of healthy river systems, such as fishing and recreational boating.
7. Protect wildlife habitat.
8. Protect or improve endangered species habitat and ecosystem health.
9. Protect human health and natural resources.
10. Protect or improve water quality.

Watershed Management Strategies

1. Using best management practices, modify the structure of forests to allow the natural process of ground fires to maintain a more resilient forest.
2. Increase ground cover, such as grasses and permeable pavement, bioretention basins, rain gardens, vegetated swales, and depressions and infiltration trenches, as appropriate to impede the intensity of runoff and promote infiltration.
3. Increase a mosaic of native vegetation and habitat types along riparian corridors to improve habitat for wildlife and aquatic species and stabilize river banks with vegetation.
4. Improve rangeland health and resilience through practices that increase soil organic matter, reduce erosion, and increase the resilience of the landscape during drought and flood events.
5. Restore, enhance, and expand wetlands to improve water storage, water quality, and flood attenuation, particularly in areas vulnerable to catastrophic wildfires, while minimizing increases in water consumption.
6. Support community watershed organizations.
7. Support habitat for threatened and endangered species.
8. Support monitoring and mapping of restoration efforts currently pursued by New Mexico Forest and Watershed Restoration Institute.
9. Support the collaboration between federal and state agencies, including New Mexico Environment Department (NMED), NMDGF, USFS, USBLM, NRCS, SWCD, and the State Forestry Division in terrestrial and aquatic watershed restoration efforts.
10. Update flood plain maps based on forecast climate conditions and identify areas that require more careful management of floodplain development.
11. Develop methods to prioritize restoration efforts to achieve the greatest impact.
12. Support research to quantify the impact of vegetation management on water resources.
13. Support the creation of watershed management funds, such as the Rio Grande Water Fund, to develop innovative financing mechanisms for watershed management.
14. Support the development of source water protection plans for every water supplier in the state.
15. Support the development of stormwater management plans, particularly in urban areas.
16. Support and fund the Strategic Water Reserve to meet interstate stream compact obligations and court decrees as well as protect endangered species.
17. Support research on the effects of changing climatic conditions on watersheds and water supplies and support efforts to disseminate this information to water/natural resource managers and the public.

In summary, the state of New Mexico and tribal, federal, and private land managers should manage forests, rangeland, urban, and riparian areas to improve resilience to drought, fire, and severe storm events. They should prioritize funding for planning and implementing forest treatments in watersheds that impact streams which supply or deliver surface water to public water systems.

Communities downstream of forested watershed need to develop and implement strategies to prepare for post-fire debris flows that often occur following high-intensity forest fires. Collaboration and periodic convening of stakeholders would facilitate the sharing of information and develop best management practices for forest and riparian restoration techniques.

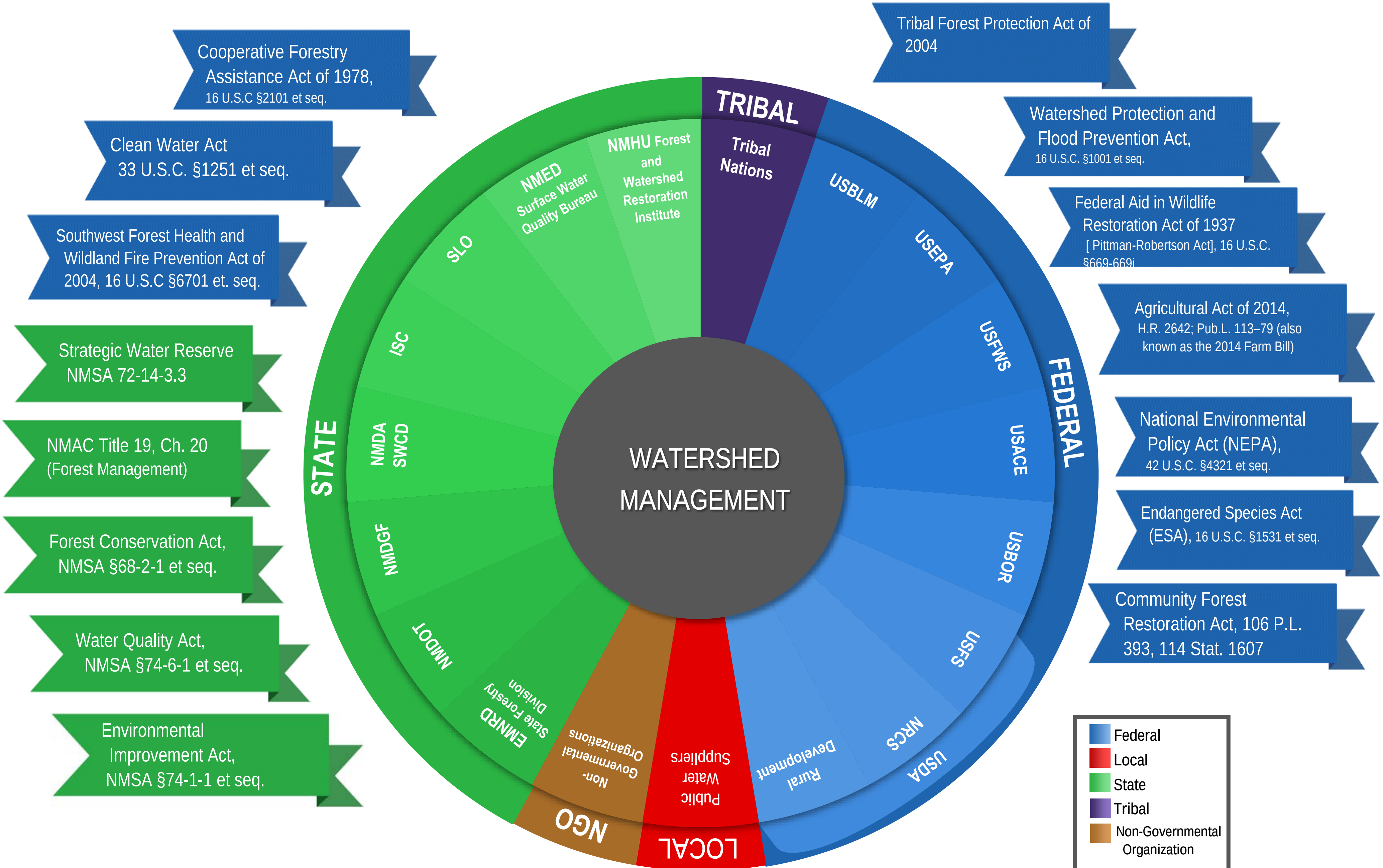

Figure 4. Statutes and Organizations Related to Watershed Management

Table 4. Directory of Primary Organizations Related to Watershed Management

Activity	Government Agencies
Forest Restoration	NM Energy Minerals and Natural Resources Department State Forestry Division ▪ Manages the Forest and Watershed Health Program ▪ Supports watershed restoration projects ▪ Develops forest action plans
	NM Energy Minerals and Natural Resources Department State Parks Division
	US Bureau of Reclamation WaterSMART Programs ▪ Conducts vegetation management ▪ Cooperative Watershed Management Programs
	NM Highlands University Forest and Watershed Restoration Institute ▪ Provides information about forest and watershed restoration ▪ Collaborates with stakeholders ▪ Promotes ecological restoration
	US Department of Agriculture Forest Service ▪ Conducts forest management ▪ Collaborative Forest Restoration Program (New Mexico) ▪ Collaborative Forest Landscape Restoration Program (National) ▪ Watershed Restoration Program ▪ Watershed Condition Framework Initiative ▪ Rocky Mountain Research Station
	US Department of Agriculture Natural Resources Conservation Service ▪ Emergency Watershed Protection ▪ Watershed Surveys and Planning NM Department of Agriculture ▪ Soil and Water Conservation Districts
	NM State Land Office ▪ Targets Wildland and Urban Interface areas for forest treatment NM Department of Game & Fish ▪ Consultation of proposed project to protect wildlife and habitat ▪ Forest restoration
	US Bureau of Land Management ▪ Forest and rangeland treatments
	NM Environment Department Surface Water Quality Bureau ▪ Monitoring, assessment, and standards ▪ Watershed protection ▪ NM River Stewardship Program ▪ Wetlands Program US Bureau of Indian Affairs ▪ Reserved Treaty Rights Lands Plan

Table 4. Directory of Primary Organizations Related to Watershed Management (Continued)

Activity	Government Agencies
Riparian Restoration & Protection	US Environmental Protection Agency ▪ Funding of state and tribal Programs for Water Quality Standards US Department of Agriculture Forest Service ▪ Riparian and aquatic ecosystem restoration
	US Fish and Wildlife Service ▪ Endangered Species Consultation ▪ National Wildlife Refuge System ▪ Habitat Conservation Plans
	US Bureau of Reclamation WaterSMART Programs ▪ River restoration ▪ Vegetation management ▪ Endangered Species Act compliance
	Tribal Nations ▪ Water Quality Standards ▪ Riparian Restoration
	US Army Corps of Engineers ▪ Section 404 Permits ▪ Environmental Resources Section ▪ Ecosystem restoration
	NM Bureau of Land Management ▪ Restore New Mexico Initiative
	NM Department of Transportation ▪ Wetland and riparian mitigation and enhancement ▪ Natural channel design for flood attenuation and habitat enhancement ▪ Endangered species mitigation
	NM Department of Game & Fish ▪ Fish hatcheries and management ▪ Manage protected wildlife species identified in NM §17-2-3 ▪ Map, monitor, and restore riparian habitat
	NM Interstate Stream Commission ▪ Strategic Water Reserve implementation ▪ Monitor and address salinity ▪ Geomorphology, sediment yields ▪ Vegetation management and habitat restoration in specific areas
	NM Environment Department Surface Water Quality Bureau ▪ Monitoring, assessment, and standards ▪ Point source regulation ▪ Watershed protection ▪ NM River Stewardship Program ▪ Wetlands Program NM Department of Agriculture ▪ Soil and Water Conservation Districts
	US Department of Agriculture Natural Resources Conservation Service ▪ Emergency watershed protection ▪ Watershed surveys and planning ▪ Farm Bill

Table 4. Directory of Primary Organizations Related to Watershed Management (Continued)

Activity	Government Agencies
Stormwater Management	US Department of Agriculture Rural Development ▪ Water and Waste Disposal Loan Guarantees
	US Department of Agriculture Natural Resources Conservation Service ▪ Agricultural conservation ▪ Emergency Watershed Protection ▪ Watershed and Flood Prevention Operations ▪ Watershed surveys and planning ▪ Watershed rehabilitation
	NM Environment Department Surface Water Quality Bureau ▪ Monitoring, assessment, and standards ▪ Watershed protection ▪ NM River Stewardship Program ▪ Point Source Regulation (certification of federal stormwater permits)
	NM Department of Transportation ▪ Non-point source NM Department of Agriculture ▪ Soil and Water Conservation Districts
	US Army Corps of Engineers ▪ Environmental Resources Section ▪ Flood Risk Management Program
	US Environmental Protection Agency ▪ Funding of state and tribal programs for stormwater management ▪ Issuance of discharge permits under Clean Water Act Section 402

5. Water Supply and Demand Policy

Balancing water supply and demand is a constant function of water management throughout the state. Ensuring adequate supply to meet beneficial uses and future demand is a key issue voiced in many arenas, such as in most of the steering committees in the 2016-2017 Regional Water Plan updates, city and local water plans, the 2017 New Mexico State Water Plan Town Hall event, and other forums for water-related input and concerns.

PHOTO 5. SANCHEZ RANCH.
PHOTO CREDIT: LUCIA F. SANCHEZ

The State Water Plan Act at NMSA §72-14-3.1 (C)(3) states that the plan shall "include an inventory of the quantity and quality of the state's water resources, population projections and other water resource demands under a range of conditions." *Part II: Technical Report*, Sections 3 through 5 describes the supply, demand, and future projections for an "average" and "drought" scenario for the state.

Balancing supply with demand can be difficult, given the limited and highly variable annual precipitation, snowpack, and stream flow in the state. While New Mexico has significant groundwater resources in many areas, it is relatively limited when it comes to surface water, and in many cases, use of groundwater affects our streams and stream flow.

Further, for each major stream that flows through New Mexico into another state, New Mexico is required to provide certain, specific amounts of water to the downstream state. That makes it harder to meet future demands because, in most cases, it means some existing water use needs to cease for the new use to commence.

Each public water system, irrigation district, or other self-supplied system is responsible for obtaining water rights and managing their water demand within limits of those rights. Demand management tools, such as the many components of water conservation plans, irrigation district seasonal allocations, shortage sharing agreements and drought plans, will continue to be a key aspect to New Mexico's ongoing struggle to stretch supplies in an equitable manner. The OSE plays a critical role in managing the cumulative impacts on stream flow and protecting senior water rights from new uses or transfers of water rights.

Figure 5 illustrates the statutes, rules, and government institutions involved in managing water supply and demand. Table 5 lists critical government agencies that manage water rights, are tasked with meeting compact obligations and compliance with the Endangered Species Act, manage reservoirs, and evaluate the ability of supply to meet demand.

As with many policy topics, there is overlap in scope and duties. As water supply and demand issues rely so heavily on reliable data, many of these agencies are also listed in Section 2, Data Collection, Accessibility, and Monitoring Policy.

Overall, supply and demand issues encompass many water policy goals and strategies. Many agencies assist with supply and demand data tracking, as well as improving implementation of supply and demand strategies. Some initiatives are in place and continue to improve, such as water rate structures that encourage conservation, incentives for identifying new supplies, and avenues for exploring safe and viable water reuse options.

Water Supply and Demand Goals

1. Manage water resources to meet current and future water demands.
2. Meet interstate stream compact obligations.
3. Reduce water demand through conservation, technology, and reuse.
4. Explore new water supply options.

Water Supply and Demand Strategies

1. Through collaboration with local, state, tribal, and federal water resource managers, develop a format for quantifying water supply and demand for water planning; future estimates of water supply should incorporate forecast diminished surface water supplies due to increased temperatures, increased evapotranspiration, and diminished snowpack.
2. Support the investigation of opportunities where storage permits could be enhanced to support existing water supplies, while protecting existing water rights and meeting compact obligations.
3. Support the economical use of brackish, municipal wastewater, or produced water in energy development or other uses while protecting senior water rights.
4. Support efforts and collaboration toward the advancement of water source technologies, such as desalination.
5. Support the development and permitting of Underground Storage and Recovery (USR) projects.
6. Expand monitoring networks to identify potential new sources of water and improve the management of existing water supplies.
7. Develop advanced hydrological modeling to manage surface and groundwater.
8. Explore new sources of water supply by supporting groundwater investigations.
9. Support funding for new infrastructure for water supply projects.
10. Process water right applications in a timely manner.
11. Promote water efficiency and conservation to reduce demand (see also Water Conservation Strategies).
12. Support conjunctive use strategies that rely on renewable supplies when available and preserve aquifers for drought periods.
13. Monitor any gap between supply and demand.
14. Support the development of water shortage sharing agreements.
15. Explore legal mechanisms to appropriate flood flows during times when such flows are physically and legally available and environmentally sound.
16. Create an efficient, user-friendly water market system, with low transaction costs, to benefit the environmental and economic sectors that require water.
17. Meter all water use.
18. Support and fund the Strategic Water Reserve to meet interstate stream compact obligations and court decrees as well as protect endangered species.
19. Encourage county officials to consider the opinions of the OSE regarding the availability of water and whether the subdivision proposal meets the requirements of the New Mexico Subdivision Act and County Subdivision regulations.

While each public water system, irrigation district, acequia, and other self-supplied water user in the state is tasked independently with managing its own supply as well as forecasting and meeting future demands, the state of New Mexico must manage resources to protect senior water right holders and comply with interstate compacts.

The state of New Mexico needs to continue to assess the amount of water diverted (and returned) to the hydrologic system, improve the hydrologic models that are utilized in making water resource management decisions and help communities understand their water supply future.

The most glaring water supply shortfall is occurring in eastern New Mexico where some communities have less than five years of water supply remaining. State and federal agencies should support water supply projects, especially diversions from Ute Reservoir, due to the severe dewatering of the High Plains aquifer in the Northeast New Mexico planning region (see *Part II: Technical Report*, Section 3.3.2 Declining Groundwater Supplies). The Ute Reservoir Pipeline Project is critical to providing supply to alleviate the projected deficit for PWSs serving Clovis, Cannon Air Force Base, Portales, Elida, Melrose, Grady, Tucumcari, and Logan.

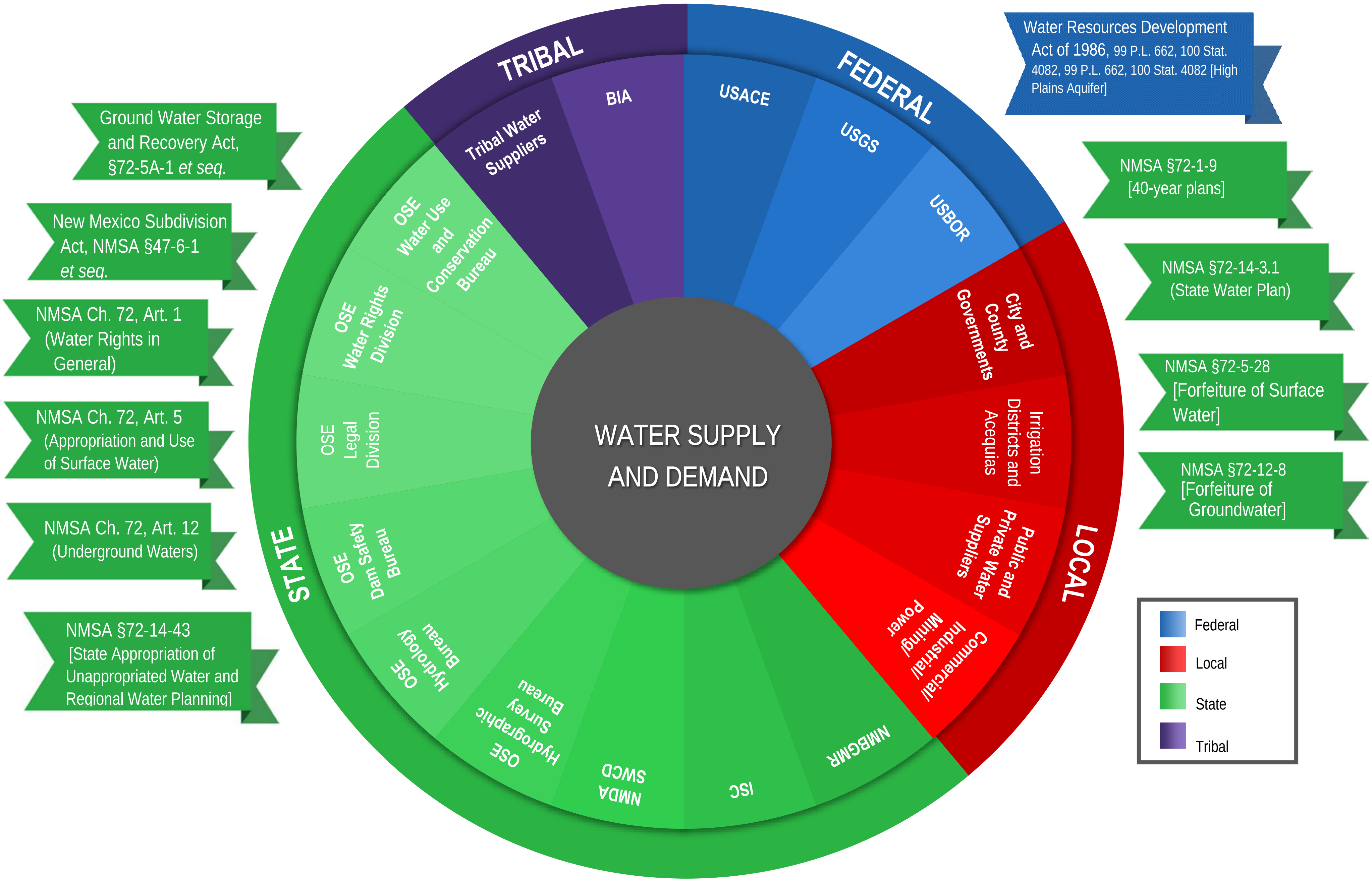

Figure 5. Statutes and Organizations Related to Water Supply and Demand

Table 5. Directory of Organizations Related to Water Supply and Demand

Activity	Government Agencies
Water Rights	**NM Office of the State Engineer** **Litigation and Adjudication Program** ▪ Oversees water rights adjudications ▪ Participates in Indian Water Rights settlements **Hydrographic Survey Bureau** ▪ Performs hydrographic surveys ▪ Establishes priority dates ▪ Establishes acres irrigated **Water Rights Division** ▪ Processes water rights applications ▪ Implements priority calls ▪ Collects metered water diversion data ▪ Administers Active Water Resource Management ▪ Manages Underground Storage and Recovery rules and regulations **Water Masters** ▪ Manages and enforces water rights ▪ Manages approved sharing agreements **Hydrology Bureau** ▪ Evaluates hydrologic effects of proposed water right transfers ▪ Conducts and reviews hydrogeologic investigations ▪ Develops guidelines for Critical Management Areas **Water Use and Conservation** ▪ Calculations for irrigation water requirements ▪ Conditions of approval for water right permits
	State Engineer Hearing Unit ▪ Conducts administrative hearings for water rights applications
	NM Interstate Stream Commission Acequia Program ▪ Supports acequia bylaws and sharing agreements
	US Department of the Interior, Indian Affairs, Branch of Water Resources ▪ Advocates for tribes in water right negotiations ▪ Manages irrigation projects and dam operations
Interstate Compacts	**NM Interstate Stream Commission** ▪ Performs duties related to Interstate Compact compliance
	US Bureau of Reclamation ▪ Manages reservoir operations and federal projects on the San Juan, Rio Grande, and Pecos rivers in accordance with compact provisions and compact commission directives
	US Army Corps of Engineers URGWOM (Upper Rio Grande Water Operations Model) ▪ Operates its reservoirs in accordance with federal statutes and interstate compacts. Conducts and refines the computational model used to complete simulations for operations of all the facilities in the Rio Grande Basin and provides the complex accounting to track water specifically allocated for different water users. ▪ Operates its reservoirs in accordance with federal statutes and interstate compacts ▪ Operates and revises the computer model used to simulate operations of all the facilities in the Rio Grande Basin and uses complex accounting to track water specifically allocated for different water users

Table 5. Directory of Organizations Related to Water Supply and Demand (Continued)

Activity	Government Agencies
Endangered Species Act Compliance	United States Bureau of Reclamation ▪ Performs baseline water assessments ▪ Operates its reservoirs under various National Environmental Policy Act Record of Decisions and Section 7 Consultations ▪ Engaged in recovery and collaborative programs
	NM Interstate Stream Commission ▪ Administers the Strategic Water Reserve ▪ Partner to the 2016 Biological Opinion for Middle Rio Grande Water Operations on the Rio Grande upstream of Elephant Butte Reservoir ▪ Coordinates with Reclamation on Pecos River Endangered Species Act activities ▪ Member of the San Juan Recovery Implementation Program
	US Fish and Wildlife Service ▪ Conducts Endangered Species Act consultations
Manage Reservoirs	NM Office of the State Engineer Dam Safety Bureau ▪ Inspects and regulates dams under state jurisdiction
	US Army Corps of Engineers ▪ Operates and maintains dams
	NM Interstate Stream Commission ▪ Estimates reservoir evaporation losses ▪ Manages Ute Reservoir ▪ Manages Eagle Nest Reservoir
	US Bureau of Reclamation ▪ Manages reservoir operations
Assess Supply Ability to Meet Demand	NM Office of the State Engineer ▪ Reviews water development plans ▪ Reviews hydrology studies and water demand analysis for proposed subdivisions ▪ Produces Water Use by Categories Report
	NM Office of the State Engineer ▪ Utilizes Active Water Resource Management to manage the state's limited water resources as an alternative to making a priority call
	NM Interstate Stream Commission ▪ Prepares engineer advisor reports ▪ Supports regional water planning and conducts state water planning
	New Mexico Bureau of Geology and Mineral Resources ▪ Groundwater investigations and assessment of new and existing resources

6. Water Conservation Policy

Water conservation is crucial for New Mexicans, as the state is located in the high desert of the Southwest, where water is limited. Water conservation that reduces the use of water or prevents waste of water is an important demand management strategy. Many water conservation measures also save energy costs and reduce the overall environmental impacts associated with water use.

Water conservation is at the center of many strategies identified in the 2016-2017 Regional Water Plan updates to reduce demand and mitigate drought (See *Part II: Technical Report*, Section 7) and all water users need to be educated about water conservation. The State Water Plan Act at NMSA §72-14-3.1 (C)(5) states that the plan shall "develop water conservation strategies and policies; to maximize beneficial use, including reuse and recycling by conjunctive management of water resources and by doing so to promote nonforfeiture of water rights.

PHOTO 6. NEW MEXICO RAIN.
PHOTO CREDIT: AMY C. LEWIS

Furthermore, state water law requires that applications for a permit to divert water from a well or stream be evaluated by the State Engineer to determine not only if the water is available for appropriation and if the proposed purpose and place of use will impair existing rights, but also whether the proposed use is contrary to the conservation of water or is detrimental to public welfare. New Mexico's semi-arid climate, the likelihood of extended and severe drought, population growth, and water shortages all contribute to a need to conserve water resources to sustain New Mexico's communities, ecosystems, and economy. Many communities have taken great strides to reduce their per capita water consumption, and the potential for greater reductions is examined in *Part II: Technical Report, Appendix 2C.*

Figure 6 is a chart of many institutions involved in assisting communities with water conservation and education about water use, as well as statutes and rules that support water conservation. The directory shown in Table 6 lists organizations that may provide conservation resources related to public water systems, agricultural water systems, and wastewater reuse.

Water Conservation Goals

1. Promote water conservation and the efficient use of water in all categories of water use.
2. Reduce water demand.
3. Reduce water consumption.
4. Eliminate water waste.

Water Conservation Strategies

1. Require metering or measuring of water diversions and return flows to improve accuracy of water use data.
2. Support the use of recycled water or alternative sources of water in place of potable water when economically feasible.

3. Engage public water suppliers in water conservation planning and encourage small water systems to take advantage of capacity building or other assistance offered through state programs.
4. Encourage agricultural water conservation methods that do not increase consumptive use and advance soil health.
5. Encourage water conservation measures to be developed in local and regional water plans and in building codes.
6. Provide water conservation education and raise awareness about water conservation strategies statewide.
7. Encourage the use of incentives and enforcement strategies to promote water conservation; at a minimum, and as an example, water bills should be based on the amount of water used by each customer, incentivizing reduced use.
8. Coordinate efforts to promote conservation among local, state, federal, and tribal governments.
9. Assist agricultural organizations, public water systems, and other agencies with creating and presenting informational programs for innovative water conservation strategies.

In summary, various mechanisms to promote and incentivize water conservation should be explored and implemented by all state, federal, tribal, and local governments, public and private water systems, and individual water users. Water conservation in the agricultural water use category should be implemented in locations where the hydrologic setting does not result in unintended consequences of reducing the return flow required by downstream users.

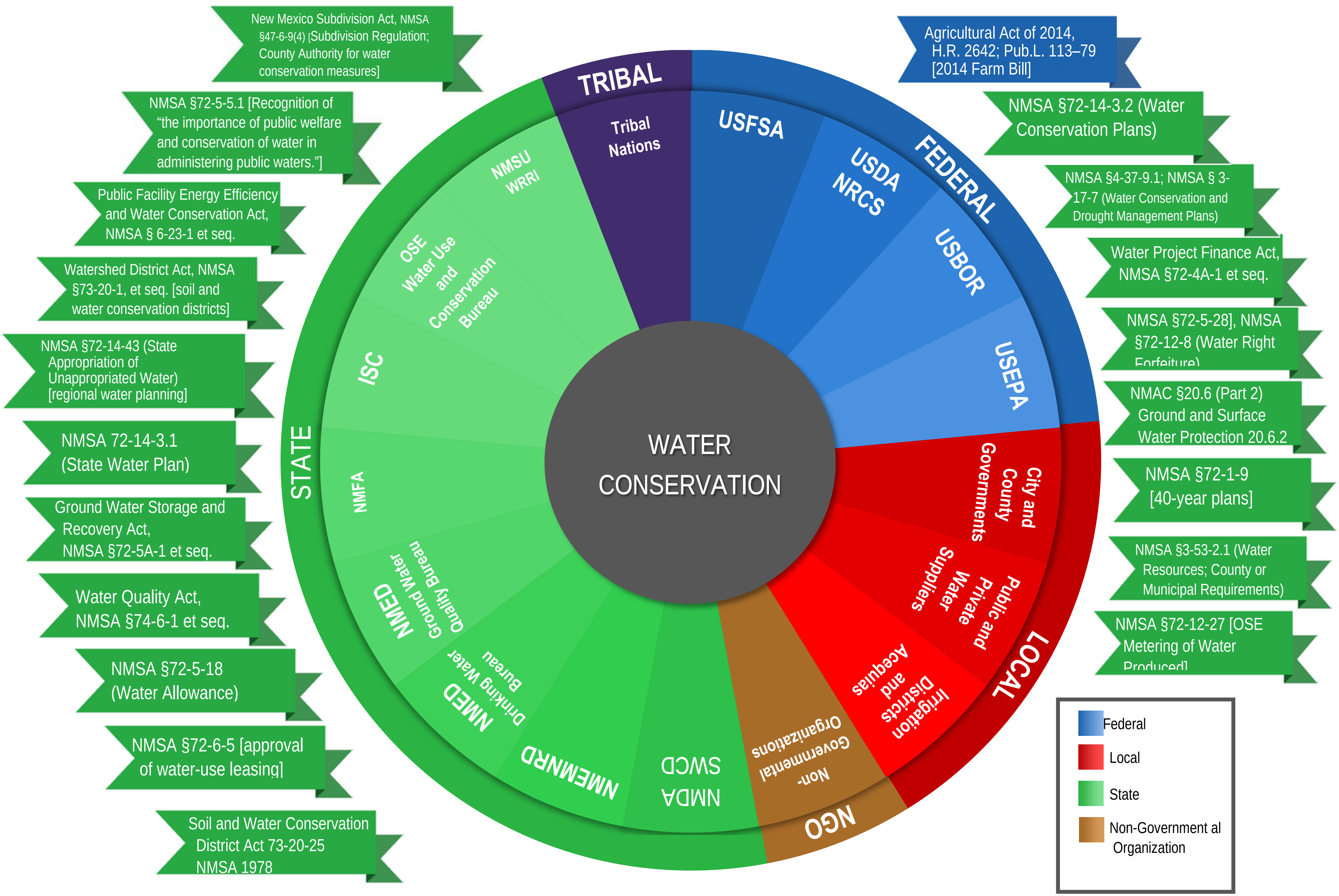

Figure 6. Statutes and Organizations Related to Water Conservation

Table 6. Directory of Organizations Related to Water Conservation

Type of Water System	Government Agencies
Public Water Systems	US Bureau of Reclamation ▪ Provides funding and support through the programs: WaterSMART, Water and Energy Efficiency Grants, Small-Scale Efficiency Projects, and Water Conservation Field Services Program
	US Environmental Protection Agency ▪ Provides support and educational materials through the Drought Resilience and Water Conservation Program, WaterSense Program, Fix a Leak Week and Water Conservation Plan Guidelines
	NM Environment Department Drinking Water Bureau ▪ Provides funding and support through the Source Water Protection Program and the Drinking Water State Revolving Loan Fund, water conservation projects may be eligible
	NM Finance Authority ▪ Administers the Water Trust Board and Water Project Fund ▪ Water Conservation projects may be eligible for funding through the Water Project Fund
	NM Interstate Stream Commission ▪ Conducts regional and state water planning programs
	NM Office of the State Engineer Water Use and Conservation Bureau ▪ Provides educational materials and other resources ▪ Developed the NM Water Conservation Planning Guide for Public Water Suppliers ▪ Reviews water conservation plans for public water suppliers ▪ Developed the Office of the State Engineer Gallons Per Capita Per Day Calculator
	New Mexico State University ▪ New Mexico Water Resources Research Institute
Agricultural Water Systems	US Department of Agriculture Natural Resources Conservation Service ▪ Farm Bill ▪ Conservation Stewardship Program ▪ Environmental Quality Incentives Program ▪ Agricultural Conservation Easement Program ▪ Financial assistance programs ▪ Technical assistance programs
	US Department of Agriculture Farm Service Agency ▪ Emergency Conservation Program ▪ Source Water Protection Program
	NM Department of Agriculture ▪ Agricultural programs and resources ▪ Acequia and Community Ditch Fund ▪ New Mexico Soil and Water Conservation Districts
	NM Interstate Stream Commission ▪ Regional and state water planning programs ▪ Acequia Program

Table 6. Directory of Organizations Related to Water Conservation (Continued)

Type of Water System	Government Agencies
Wastewater Reuse Systems	NM Environment Department Ground Water Quality Bureau ▪ Provides guidelines for treatment standards for wastewater and regulates reuse through discharge permits for reclaimed wastewater use
	NM Energy, Minerals, and Natural Resources Department ▪ Energy Conservation and Management Division ▪ Wastewater Efficiency Program, Waste Not ▪ Oil Conservation District: permits for produced water reuse
	NM Interstate Stream Commission ▪ Regional and state water planning programs
	US Bureau of Reclamation ▪ Title XVI Water Reclamation and Reuse
	NM Finance Authority ▪ Administers the Water Trust Board and Water Project Fund ▪ Water Conservation projects may be eligible for funding through the Water Project Fund

7. Water Quality Policy

The state of New Mexico, nations, tribes, and pueblos, USEPA, and United States Army Corps of Engineers (USACE) implement numerous programs to protect water quality, which include regulating the discharge of contaminants to surface and groundwater, monitoring and protecting drinking water, protecting aquatic and terrestrial species and public health.

PHOTO 7. VISTA NEAR VELARDE.
PHOTO CREDIT: B.J. BUMGARNER ON FLICKR

The State Water Plan Act at NMSA §72-14-3.1 (B)(4) states that the State Water Plan shall be a tool for "protecting both the water supply and water quality" and NMSA §72-14-3.1 (C)(3)) states that the plan shall "include an inventory of the quality of the state's water resources…"

Surface and groundwater quality information is included in each of the 2016-2017 Regional Water Plan updates, including detailed maps of impaired reaches. A summary of the water quality issues identified in the 2016-2017 Regional Water Plan updates is provided in *Part II: Technical Report,* Section 6.5). These issues range from naturally occurring arsenic and uranium to contamination of groundwater from mining and industry to the impacts of septic tanks on surface water and groundwater.

Approved Tribal Water Quality Standards:

- Navajo Nation
- Pueblo of Acoma
- Pueblo of Isleta
- Pueblo of Laguna
- Pueblo of Nambe
- Pueblo of Ohkay Owingeh
- Pueblo of Picuris
- Pueblo of Pojoaque
- Pueblo of Sandia
- Pueblo of Santa Ana
- Pueblo of Santa Clara
- Pueblo of Taos
- Pueblo of Tesuque

Water quality that meets the standards necessary to protect human health and agricultural uses while supporting aquatic life and wildlife habitat is inextricably linked to providing sufficient water quantity. Statutes and agencies important to water quality protection are illustrated in Figure 7. Further information is provided in the legal section of each of the Regional Water Plan updates (ISC, 2016-2017). Table 7 provides a list of the agencies with regulatory oversight associated with the various activities that may contaminate water quality.

New Mexico passed the State Water Quality Act in 1977 (§§ 74-6-1 et seq., NMSA 1978), which established the New Mexico Water Quality Control Commission (NMWQCC), as well as the first significant groundwater protection program in the country. The NMWQCC comprises state, tribal, and local representatives.

The Environmental Improvement Act imposes a water conservation fee for public water supply systems to fund tests of public water supplies for contaminants as required by the Safe Drinking Water Act; perform vulnerability assessments; and to provide training for water supply operators. Responsibility for protection of New Mexico's water quality is shared among these governmental entities. Today, we enjoy clean water from our taps and healthy habitat for our flora and fauna because of the network of government agencies tasked with water quality protection.

Protection of water quality involves establishment of scientifically based chemical, physical, and biological standards necessary to support designated uses identified in the State Water Quality Standards (NMAC 20.6.4) and individually promulgated Tribal Water Quality Standards. Each lake, river, and stream in New Mexico has designated uses, which may include domestic water supply, public water supply, irrigation, livestock watering, primary or secondary contact, wildlife habitat, and/or one of several aquatic life uses (e.g., high-quality cold-water aquatic life) (Franklin, 2018). Surface water discharge permits typically include effluent limits set to ensure that water quality standards are met at a critical low flow. Water management policy that maintains flow above the critical low flows help ensure that streams support their designated uses.

Water Quality Goals

1. Provide safe drinking water for public water systems and domestic wells.
2. Provide water suitable for irrigation.
3. Protect aquatic life.
4. Protect wildlife habitat, livestock watering, and recreational opportunities.
5. Protect human health and natural resources.
6. Protect water for cultural uses.
7. Ensure that public and elected officials understand the value of protecting water quality.

Water Quality Strategies

1. Continue to support the federal, tribal, and state programs that protect water quality; including the Federal Clean Water Act, New Mexico Water Quality Act, New Mexico Wildlife Conservation Act, and the Endangered Species Act (see Figure 7).
2. Continue to support the water quality protection programs within state agencies, such as the NMED, NMDGF, and the NMEMNRD.
3. Continue to review and update Water Quality Standards for the state of New Mexico and continue to assist nations, tribes, and pueblos with their Water Quality Standards and water quality protection.
4. Support monitoring and assessment of water quality from groundwater and surface water.
5. Continue to support watershed management, including uplands, forest, wetland, and riparian restoration and urban stormwater management to improve downstream water quality.
6. Support educational outreach efforts on behalf of state, tribal, and federal agencies.
7. Provide funding opportunities for water quality protection and remediation of contamination.
8. Consider forming Flood Control Districts or proposing planning and zoning standards to help municipalities and counties protect drainages, streams, and rivers, and incorporate stormwater management into site plan designs.
9. Increase funding for groundwater orphan sites to assess and potentially clean up contaminated sites that are not covered by the Corrective Action Fund (which is now only for petroleum contamination cleanup).

In summary, the agencies and programs in place to protect water quality for humans and the ecosystem should continue to be supported. A funding source should be identified to address lingering contamination in groundwater that is not covered by the Corrective Action Fund.

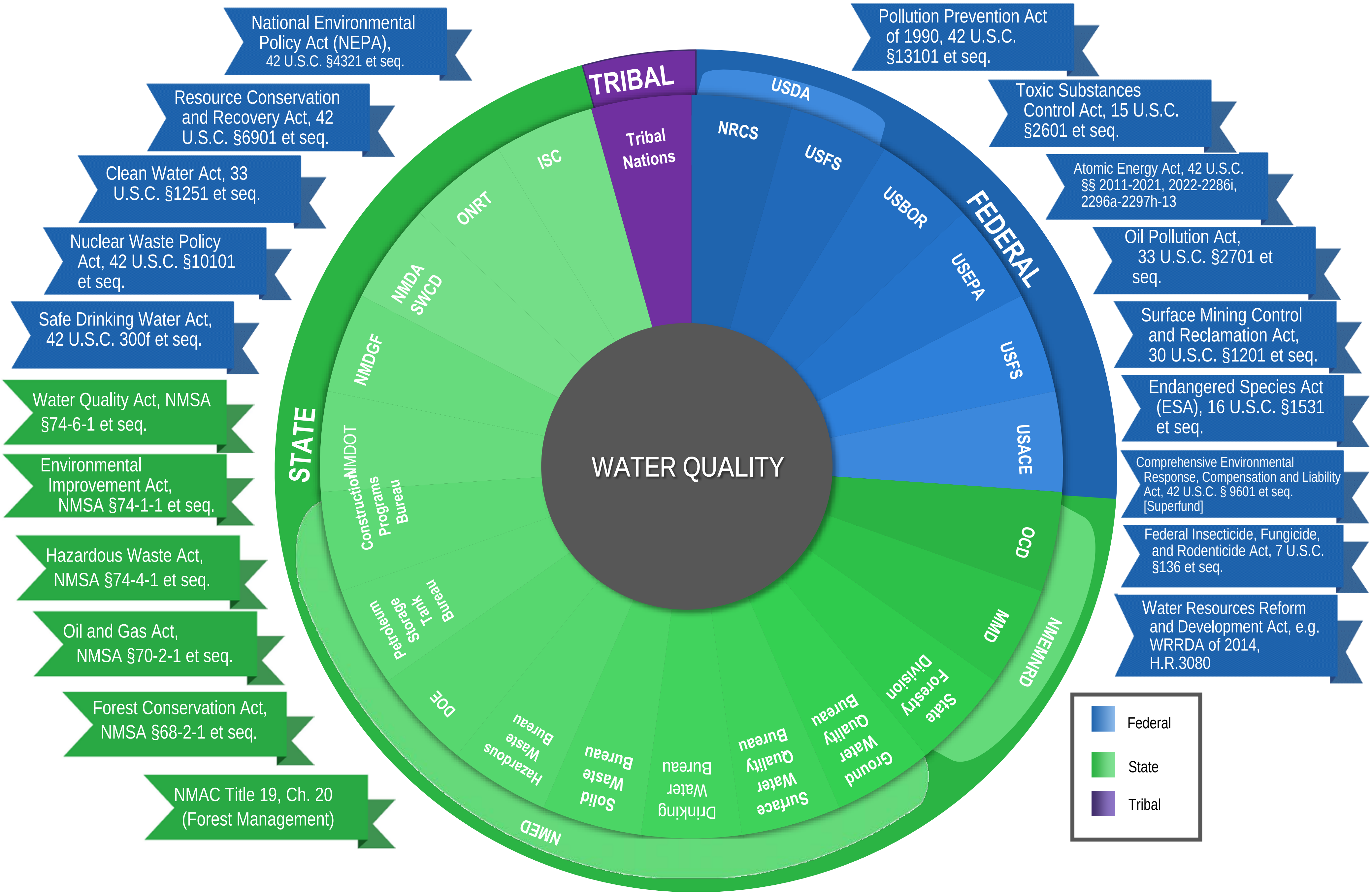

Figure 7. Statutes and Organizations Related to Water Quality Protection

Table 7. Directory of Essential Organizations Related to Water Quality Protection

Activity	Government Agencies
Discharging Pollutants to Groundwater	NM Environment Department Ground Water Quality Bureau ▪ Pollution prevention ▪ Agricultural compliance
	Tribal Environmental Departments
Discharging Pollutants to Surface water	US Environmental Protection Agency
	NM Environment Department Surface Water Quality Bureau
	Tribal Environmental Departments
	US Department of Agriculture Natural Resource Conservation Service
	NM Department of Agriculture
Drinking Water Oversight	NM Environment Department Drinking Water Bureau NM Environment Department Construction Programs Bureau
Storing Petroleum Products in Tanks	NM Environment Department Petroleum Storage Tank Bureau
Handling Hazardous Waste	NM Environment Department Hazardous Waste Bureau
	NM Environment Department of Energy Oversight Bureau
Disposing Solid Waste to Landfill	NM Environment Department Solid Waste Bureau
Extracting Mineral Resources	NM Energy Minerals and Natural Resources Department Mining and Minerals Division
	NM Environment Department Ground Water Quality Bureau ▪ Mining environmental compliance
Producing Petroleum Products	NM Energy Minerals and Natural Resources Department Oil Conservation Division

Table 7. Directory of Essential Organizations Related to Water Quality Protection (Continued)

Activity	Government Agencies
Reclamation of Polluted Sites	US Army Corps of Engineers ▪ Restoration of Defense Sites ▪ Restoration of Abandoned Mine Sites
	NM Environment Department Ground Water Quality Bureau ▪ Remediation Oversight ▪ Superfund Oversight
	Office of the Natural Resources Trustee Energy, Minerals and Natural Resources Department New Mexico Mining and Minerals Division ▪ Abandoned Mines Land Program
Managing Ecosystem Health *ESA Flows* *Forest Conditions* *Riparian Conditions* *Stormwater*	NM Interstate Stream Commission NM Department of Agriculture ▪ Soil and Water Conservation Districts
	NM Department of Game & Fish ▪ Riparian, wetland, and forest restoration ▪ State Wildlife Action Plan US Bureau of Reclamation
	US Fish and Wildlife Service
	US Department of Agriculture US Forest Service
	US Army Corps of Engineers Section 404
	US Department of Agriculture Natural Resource Conservation Service
	NM Department of Transportation
	US Environmental Protection Agency
	NM Environment Department Surface Water Quality Bureau

8. Water Planning Policy

Water planning ranges in scale; from the small mutual domestic water system that must consider its rate structure to pay for operation and maintenance costs, to the large municipality that forecasts population growth to determine the ability of water supply to meet future demands, to the state as a whole for compliance with interstate compacts.

Water planning is also vital to determining infrastructure needs and to demonstrating that New Mexico has future plans for all of the water within the state. Thus, water plans have multiple purposes from providing information to potential users so that they can make their own planning choices, to providing suggestions so that regional and local goals can be achieved to educating decision-makers and highlighting the need for programs and continued or expanded funding.

PHOTO 8. ACEQUIA DE ALCALDE LIMPIA, 2018.
PHOTO CREDIT: LUCIA F. SANCHEZ

Including this policy goal for water planning within the State Water Plan is for the purpose of reinforcing the need for continued planning at all levels; to illustrate the multiple agencies and organizations that support local, regional and state water planning; and to acknowledge the need for coordination and public participation in the planning process.

The State Water Plan Act at NMSA §72-14-3.1 (F) outlines the need for public participation throughout the planning process. Public outreach and stakeholder involvement were identified as a key collaborative strategy in *Part II: Technical Report,* Section 7.1, along with continued water planning.

Communities at all levels must continually evaluate their water supply system's ability to meet current needs, future demands, and peak daily demands in all seasons. Water-level declines in aquifers and vulnerability of surface supplies during drought are forefront in these evaluations.

The New Mexico legislature created the Water Planning Program in 1987 and designated the ISC to oversee the program. The original Water Planning Program was directed to lead water planning and management at the regional level. Regional planning provides an opportunity for input from all area stakeholders and for collaborative effort to address local concerns.

Figure 8 shows the rules, regulations, acts, and stakeholders involved in water planning. Table 8 identifies the critical government and non-government organizations that provide regulation, guidance, or resources related to this water planning policy.

Water Planning Goals

1. Develop a comprehensive, coordinated State Water Plan.
2. Continue to improve and update the State Water Plan every five years.
3. Support continued regional water planning efforts.
4. Integrate regional water plans as they are updated into the State Water Plan.

5. Develop water plans to address water supply, demand, and changing conditions; and create goals that will have a positive impact on the public welfare of the state.
6. Ensure that the planning process is inclusive, open to the public, and transparent; and ensure the process uses best available science and data.
7. Manage water resources to maximize beneficial use.
8. Use water availability information, such as the opinions issues by the OSE during the subdivision review process, to make informed land use decisions.
9. Protect water supply and water quality.
10. Protect the customs, culture, environment, and economic health and stability of the state's diverse communities.
11. Coordinate among all levels of government and maintain effective government-to-government relationships with nations, tribes, and pueblos in decision-making processes regarding water.
12. Complete water rights adjudications.

Water Planning Strategies

1. Organize meetings or workshops to convene stakeholders to address specific water planning issues, such as watershed management and other policy topics.
2. Develop a recommended format for water planning by PWSs that allows for assimilation into regional and state water plans.
3. Allow each region of the state to plan for its water future.
4. Incorporate local water plans (such as Water Development Plans) and strategies into regional plans.
5. Support regional water planning efforts identified in regional water plans.
6. Promote ongoing regular communication and information sharing among the regional steering committees and the ISC Water Planning Program, including updating PPP lists.
7. Use the best data available to inform regional and state water plans.
8. Use water plans to provide clear information to inform water management decisions.
9. Engage in public outreach about water planning issues and support water education in elementary, middle, and high school.
10. Support implementation of water plans at various scales.
11. Make the planning process, as well as strategies included in water plans, flexible and adaptable.
12. Collaborate with the OSE and with other government agencies as appropriate.
13. Collect data about the quantity and quality of the state's water resources, population projections, and other water resource demands under a range of conditions.
14. Collaborate with the state's national laboratories and research institutions to address important water issues on demonstration projects in desalination, conservation, watershed restoration, weather modification, and other technological approaches to enhancing water supply, management, and technology.
15. Develop statewide and regional drought management plans.
16. Identify water-related infrastructure and management investment needs and opportunities to leverage federal, state, and other funding sources.
17. Provide staff and resources to support the completion of water rights adjudications.
18. Support water rights transfer policies that provide for timely and efficient transfers of water between uses to meet both short-term shortages and long-term economic development needs.
19. Conduct government-to-government consultation with nations, tribes, and pueblos for water planning efforts, as well as water rights adjudications and settlements with Indian nations, tribes, and pueblos located wholly or partially within New Mexico.
20. Provide an opportunity for public review and comment on the State Water Plan.

21. Present the State Water Plan to the interim legislative committee that studies water and natural resources.
22. Work collaboratively across state and national borders to strive for agreements and avoid litigation.

In summary, the ISC should continue to conduct water planning through collaboration with state, tribal, federal, non-governmental organizations, and stakeholders to help move the state forward and improve the outlook for New Mexico's economy, environment, and cultural heritage.

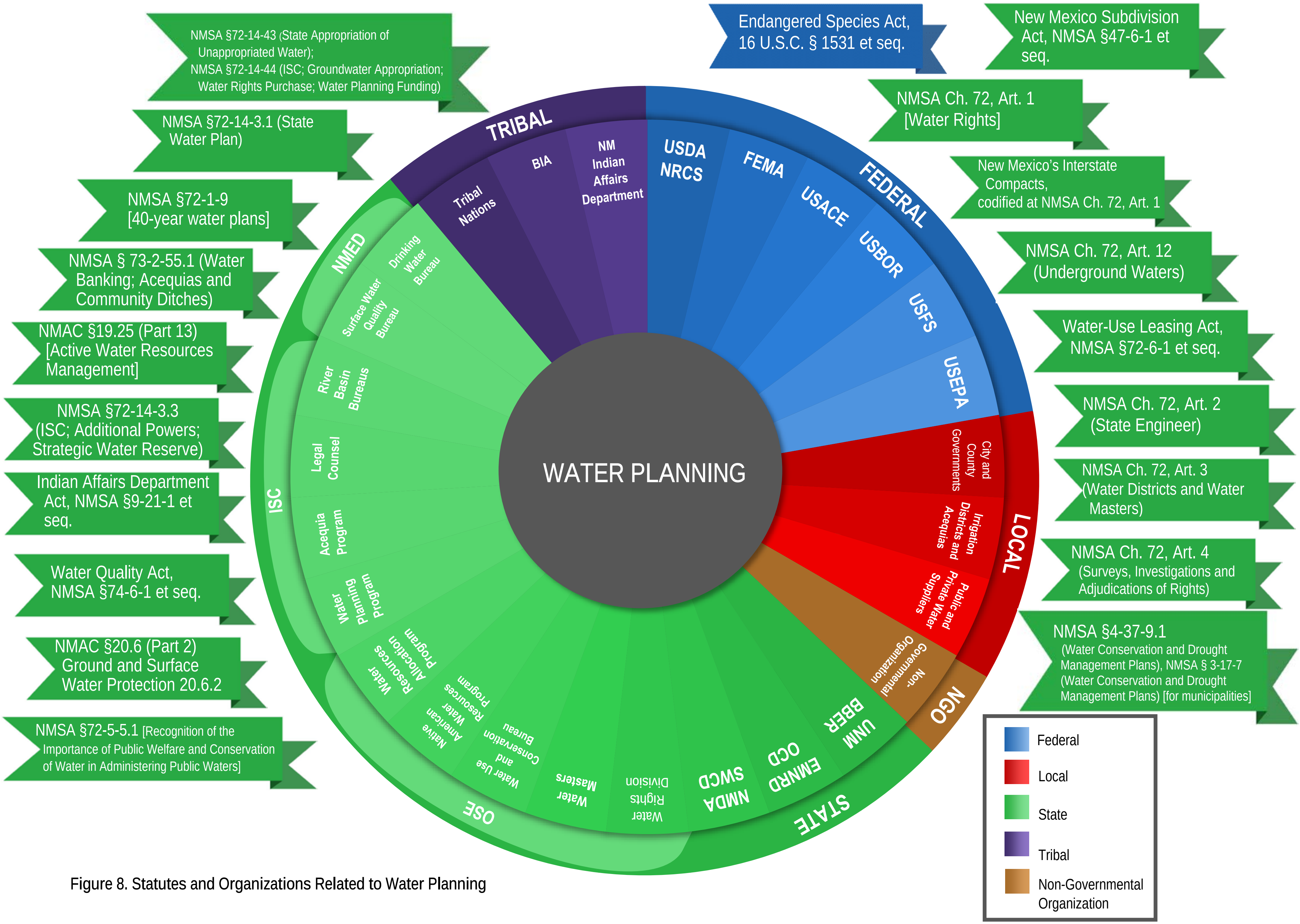

Figure 8. Statutes and Organizations Related to Water Planning

Table 8. Directory of Organizations Related to Water Planning

Activity	Government Agencies
Water Planning	**NM Interstate Stream Commission** Water Planning Program ▪ Oversees regional and state water planning program River Basin Bureaus ▪ Forecasts compliance with Interstate Stream Compacts and Settlement Agreements ▪ Collaborates with federal and state agencies and irrigation districts to meet compact obligations, settlement agreements and address Endangered Species Act issues ▪ Manages the Strategic Water Reserve Acequia Program ▪ Supports acequias by developing sharing agreements
	NM Office of the State Engineer Water Rights Division ▪ Manages WATERS Database (NMWRRS) ▪ Implements priority calls Water Use and Conservation ▪ Reviews subdivision proposals ▪ Reviews water development Plans ▪ Prepares Water Use by Category Report every five years Native American Water Resources Program ▪ Conducts government-to-government coordination and communication related to solving water issues Water Masters ▪ Calculates allowable diversions
	US Bureau of Reclamation ▪ Performs WaterSMART basin studies ▪ Manages and protects water resources through many programs
	US Army Corps of Engineers ▪ Forecasts compact compliance on the Rio Grande using Upper Rio Grande Water Operations Model (URGWOM)
	US Environmental Protection Agency ▪ Supports stormwater management planning through the Nonpoint Source Pollution Program
	NM Environment Department Surface Water Quality Bureau ▪ Provides funding and support for watershed planning through the Watershed Protection Section ▪ Conducts monitoring, assessment, and standards
	UNM Bureau of Business and Economic Research ▪ Provides information on historic population and forecasts population changes in New Mexico
	NM Department of Agriculture ▪ Soil and Water Conservation Districts
	New Mexico Water Dialogue ▪ Hosts annual statewide meeting ▪ Tracks policy-making activities in the Office of the State Engineer, the New Mexico Interstate Stream Commission, and the New Mexico Legislature
	US Department of Agriculture Natural Resource Conservation Service ▪ Prepares State Water Supply Outlook reports that forecasts runoff in river basins based on available snow pack

Table 8. Directory of Organizations Related to Water Planning (Continued)

Activity	Government Agencies
Infrastructure Planning	US Bureau of Reclamation ▪ Manages reservoir operations
	US Army Corps of Engineers ▪ Forecasts flood stage, plan, and design for flood control, dams, and canals and conducts feasibility studies
	US Forest Service ▪ Forecasts potential fire risk and impacts to water supply reservoirs
	Federal Emergency Management Agency ▪ Develops 100-year flood inundation maps
Tribal Planning	US Department of the Interior Indian Affairs, Branch of Water Resources ▪ Provides policy, oversight, and technical support functions through the Central Office Water Program ▪ Provides technical assistance to tribes; supports water rights negotiation, litigation, water management, planning, and pre-development through the regional office and Local Agency Water Program
	New Mexico Indian Affairs Department ▪ Develops state-tribal consultation policies

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Appendix 1A
Public Survey on Potential Workshops

Contents

Figures

1. Survey Background

To move forward with implementation of policies, the New Mexico Interstate Stream Commission proposes hosting a series of public engagement events in 2019 and beyond. Reviewers of the *Draft 2018 New Mexico State Water Plan* were provided an opportunity to respond to a series of questions to help prioritize and locate the events. The following is a summary of the feedback from those questions. Figure 1A-1 shows the categories of responders out of a total of 84 submissions.

As part of the public comment on the *Draft 2018 New Mexico State Water Plan*, a survey was conducted to capture the interests in future water planning events. This appendix includes feedback from a series of questions. In summary, interest in these events is high, with more than 50% of respondents interested in five out of the eight topics presented.

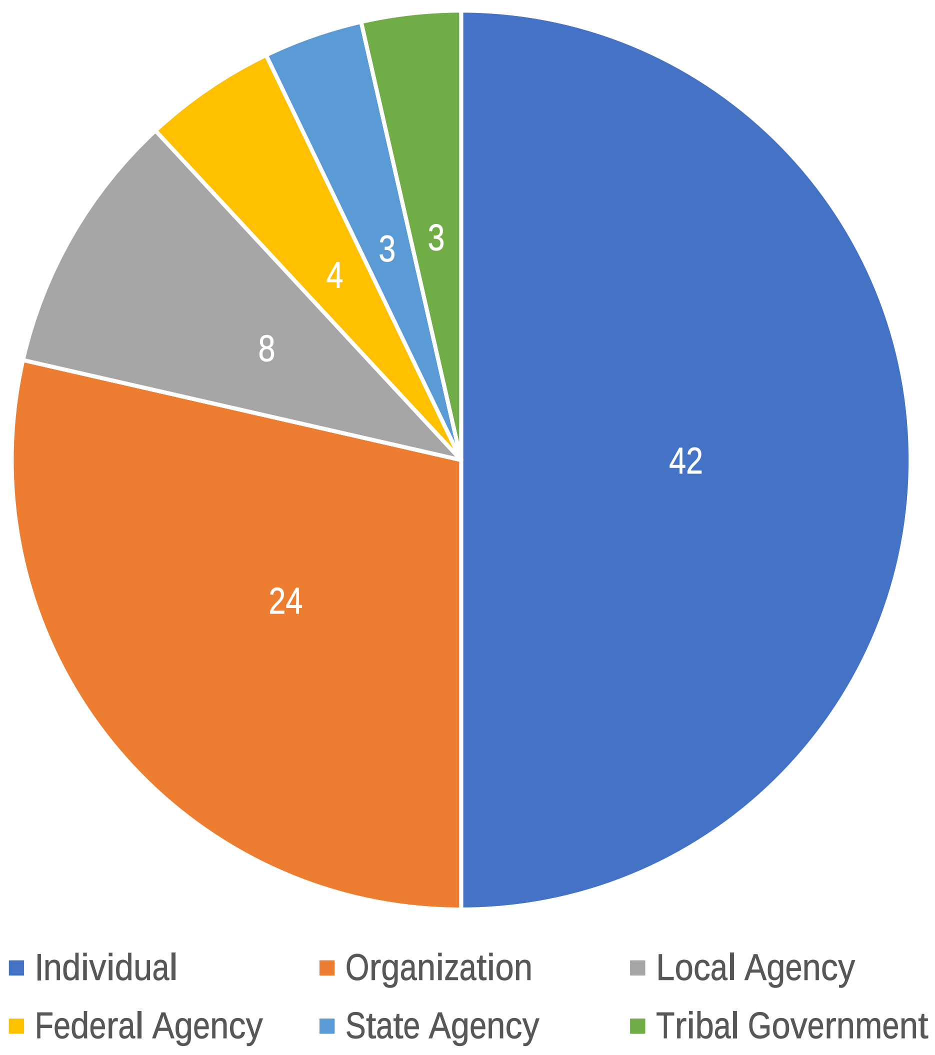


Figure 1A-1. Affiliation of Survey Responders.

Figure 1A-2 shows the geographic distribution of the various responders.

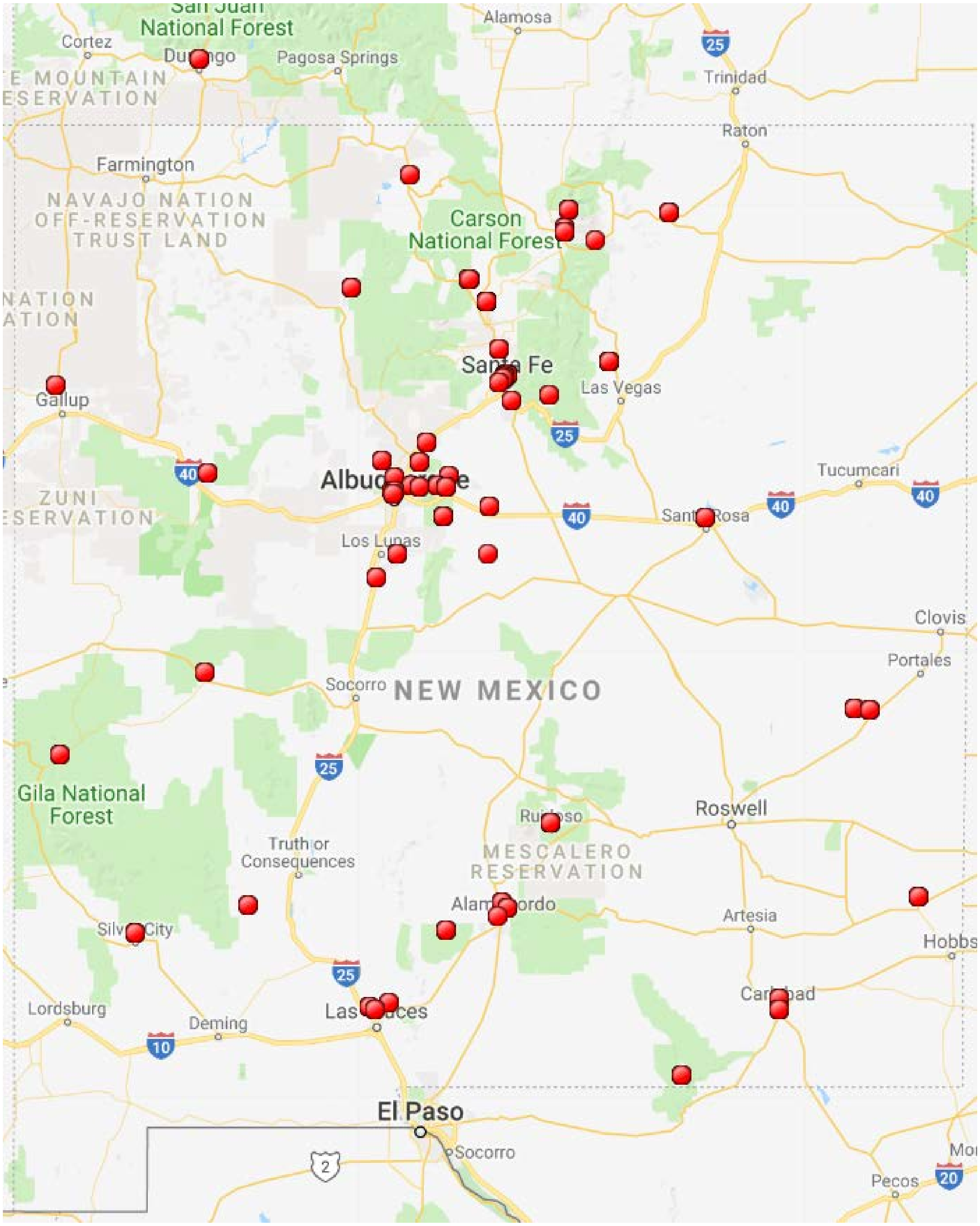
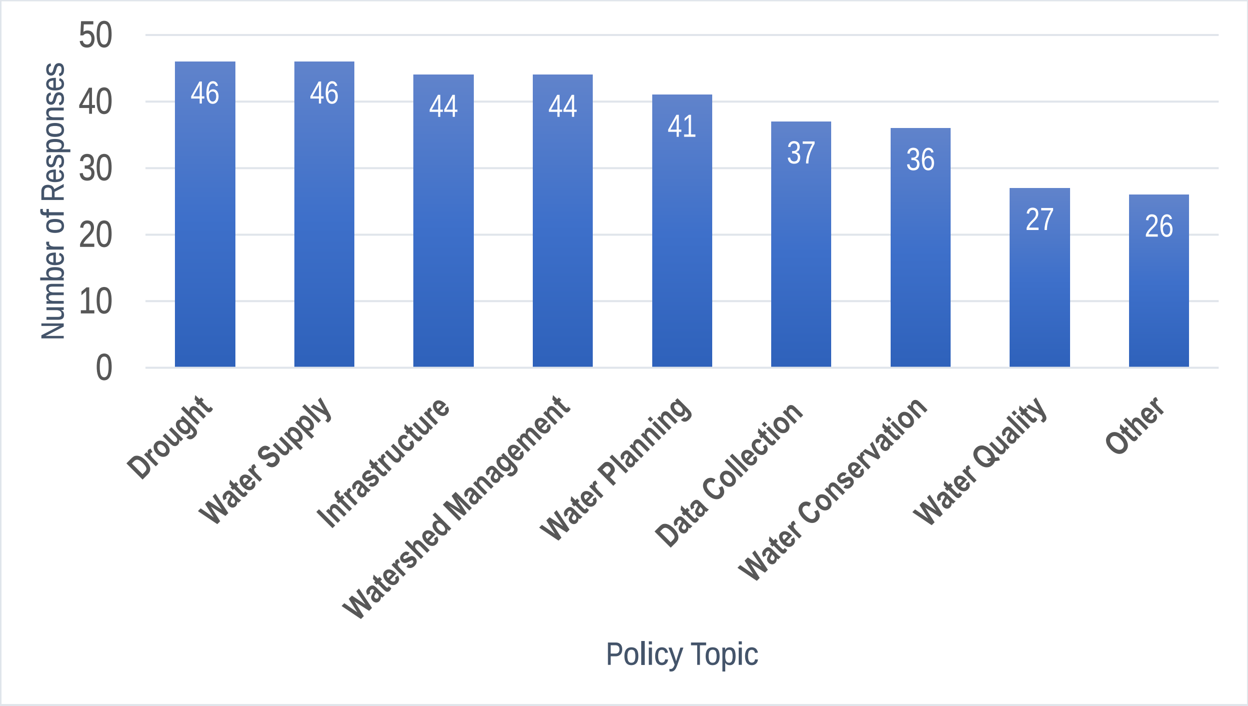


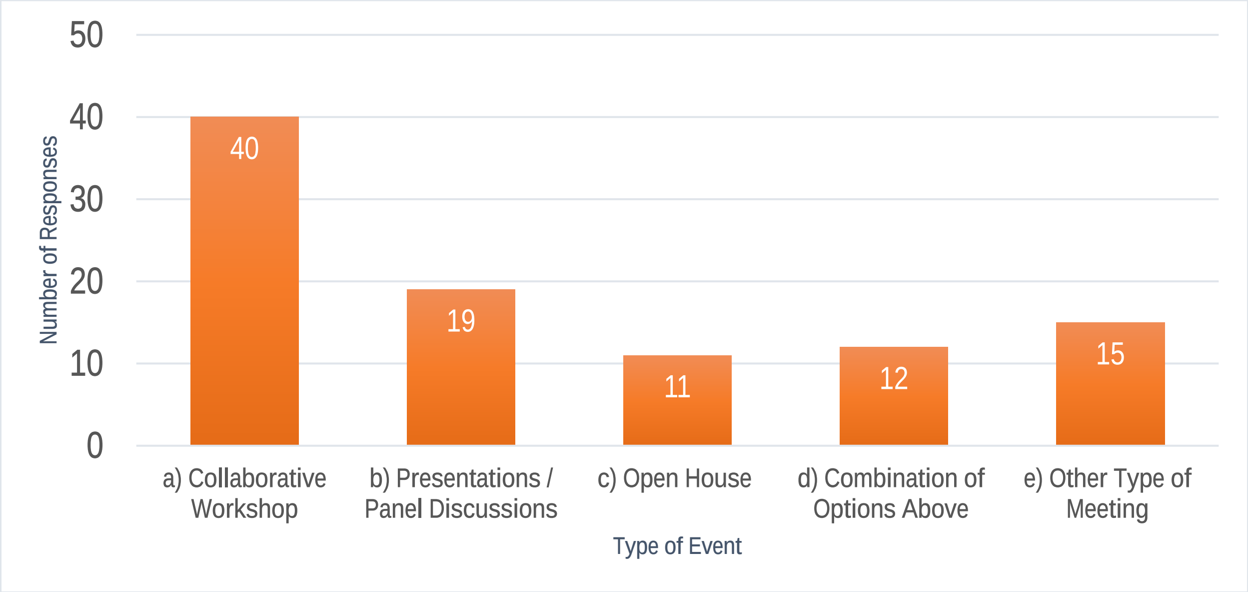
Figure 1A-2. Geographic Distribution of Responders.

2. Questions and Responses

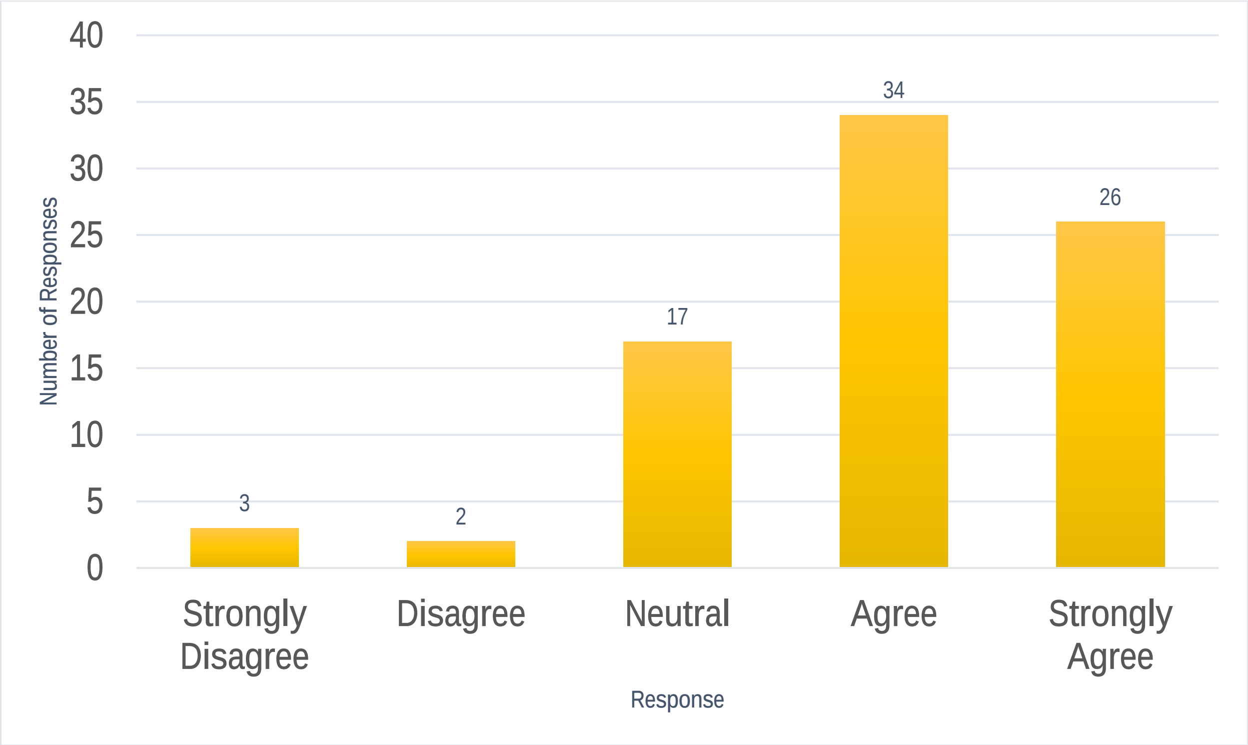
As we work to advance the State toward achieving policy goals identified in the State Water Plan, the ISC is considering organizing and hosting some public events. Would you be interested in participating in an event related to which of the following policy topics?



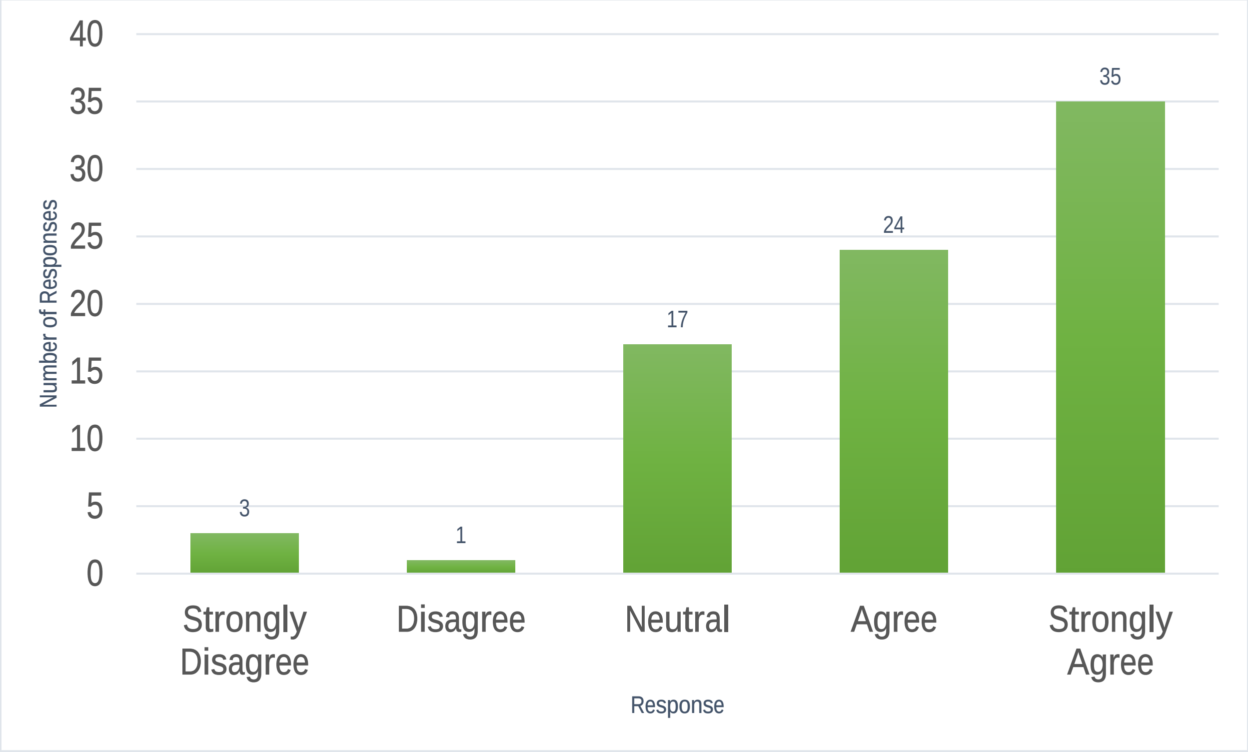
What type of event would be most useful?



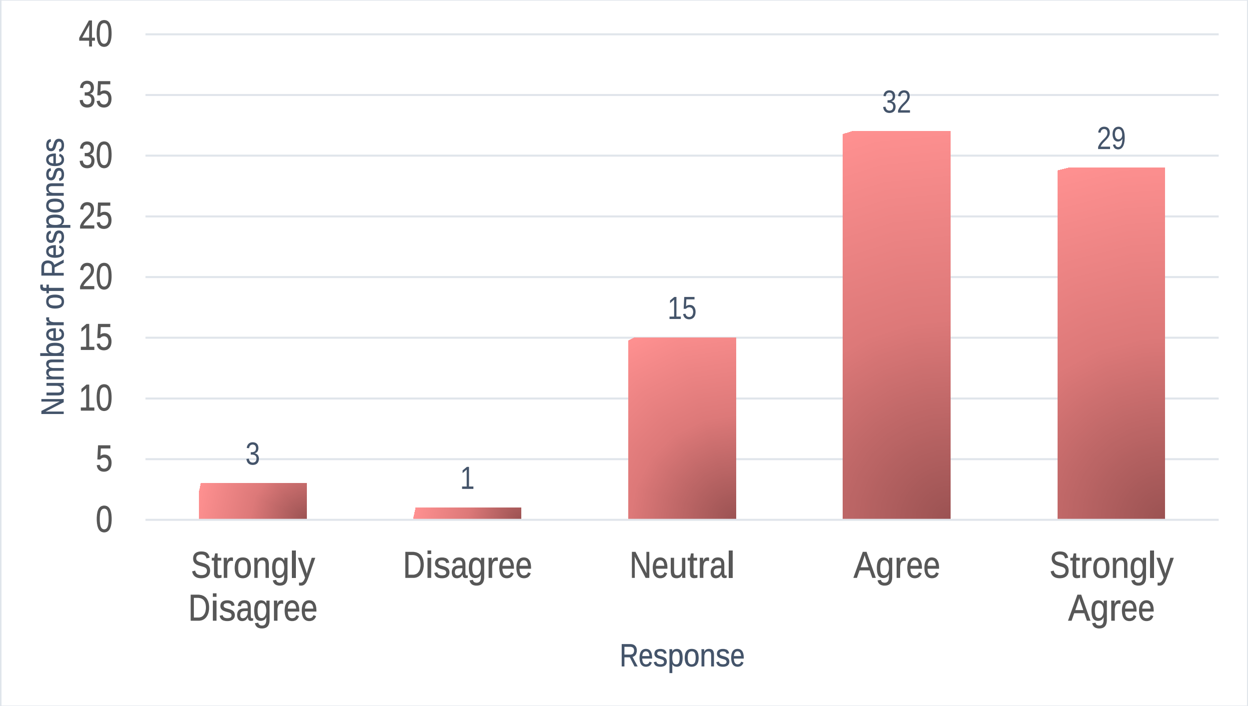
An important benefit of attending an event is to increase knowledge and understanding of scientific research.



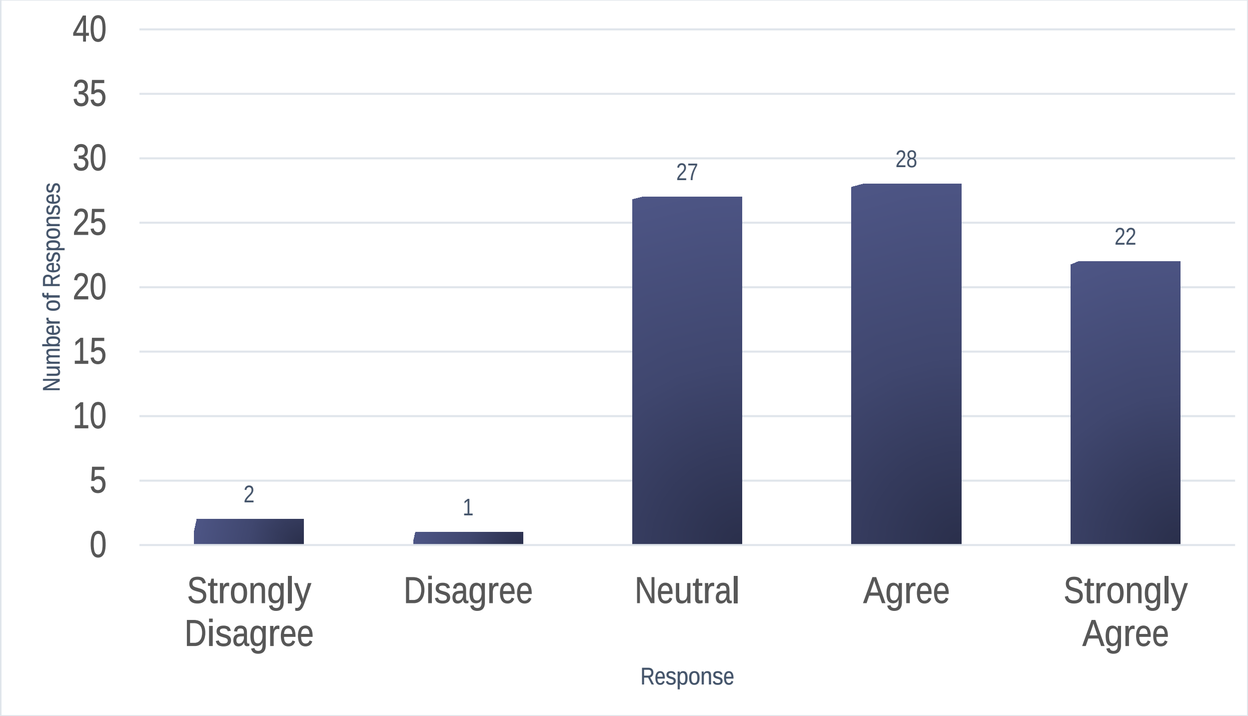
An important benefit of attending an event is collaborative problem solving.



An important benefit of attending an event is the opportunity to speak with and listen to practitioners or professionals.

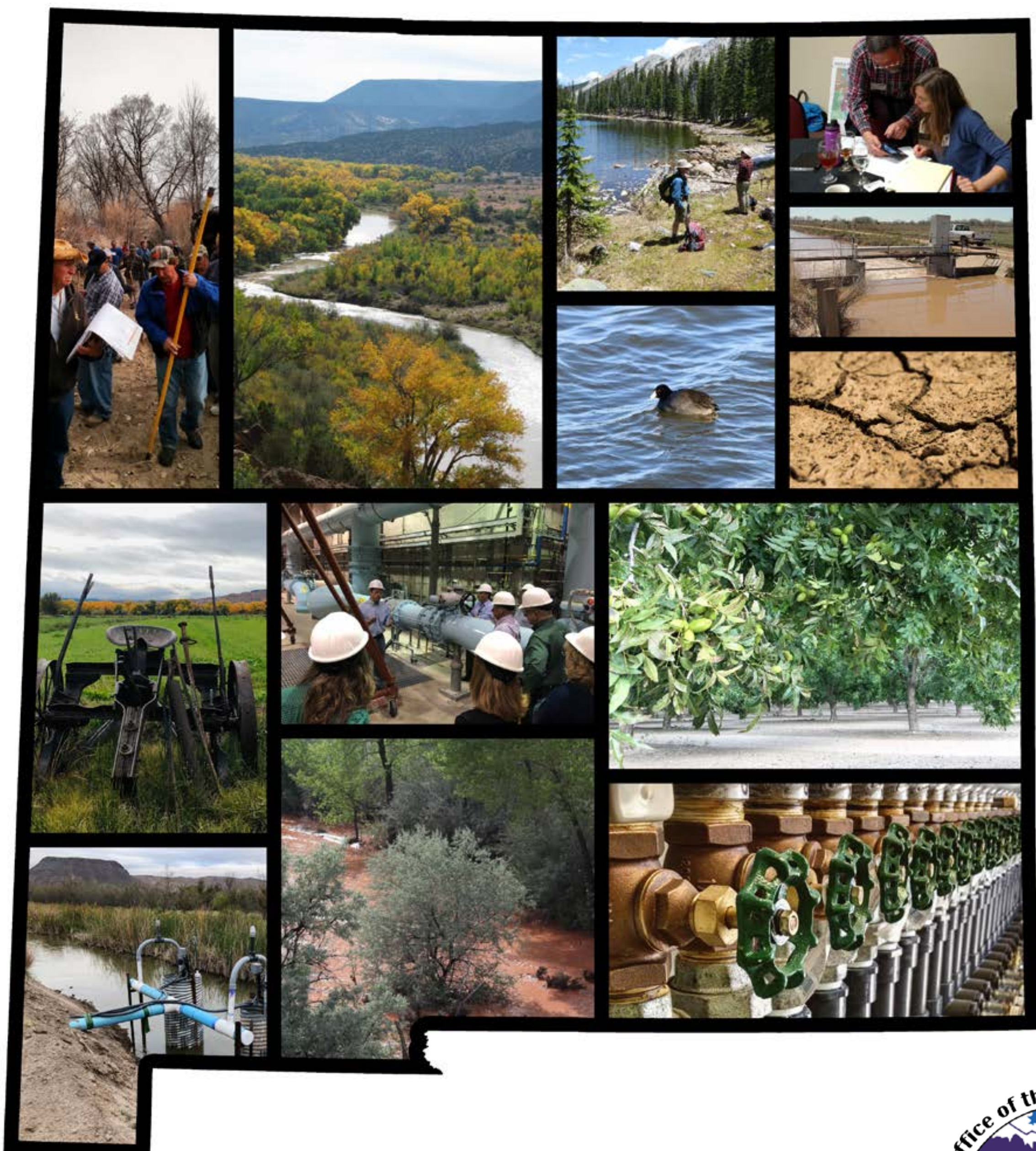


An important benefit of attending an event is to gain practical information related to daily operations.



New Mexico State Water Plan
Part II: Technical Report

Gaining a Statewide Perspective through Analysis and Integration of Water Planning Activities, Including New Mexico's 16 Regional Water Plans



Adopted by the New Mexico Interstate Stream Commission

December 6, 2018

Office of the State Engineer

Interstate Stream Commission

New Mexico State Water Plan Part II: Technical Report

Prepared by the New Mexico Interstate Stream Commission

Published 2018

The 2018 New Mexico State Water Plan is presented in three parts:

Part I: Policies presents a concise, big-picture view of the highest priority water issues in New Mexico and the policies, goals, and strategies needed to address them, as well as information about the agencies and resources available to assist with these issues.

Part II: Technical Report integrates water resource information from the Regional Water Plans completed in 2016-2017, including estimated water supply and demand, projections of population, and strategies proposed by stakeholders to address key water issues.

Part III: Legal Landmarks provides information about historical New Mexico water law decisions, events, and circumstances that shaped New Mexico's legal structures for water resource administration.

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List of Acronyms and Definitions

°C	degrees Celsius
°F	degrees Fahrenheit
ac-ft	acre-feet: amount of water that covers 1 acre of land with 1 foot of water
ac-ft/yr	acre-feet per year
CIR	consumptive irrigation requirement
closed basin	a closed basin is a basin that retains water such that no outflow to other surface water bodies occurs
COG	Council of Governments
Demand	the amount of water necessary to meet the conveyance and consumptive needs of a water use category (including return flow and depletions)
Depletion	amount of water consumed from the water withdrawn or diverted
ft	foot *or* feet
FEMA	Federal Emergency Management Agency
GIS	geographic information system
gpcd	gallons per capita per day
HUC	Hydrologic Unit Code is a numerical sequence that identifies a hydrological drainage basin (also called watershed or catchment) into successively smaller units from the largest geographic area to smaller areas. The first level (HUC 1) divides the US into 21 major geographic areas or regions, the second level (HUC 2) divides the 21 regions into 221 regions.
ICIP	New Mexico Infrastructure Capital Improvement Plan
IPCC	Intergovernmental Panel on Climate Change
ISC	New Mexico Interstate Stream Commission
M	million
m^2	meters squared
Mined Basin	aquifer in closed (no through-flowing streams) basin where recharge is much less than the discharges (through pumping and spring flow)
MRGCD	Middle Rio Grande Conservancy District
NIIP	Navajo Indian Irrigation Project
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMSA	New Mexico Statutes Annotated
NRCS	National Resources Conservation Service
OSE	New Mexico Office of the State Engineer
PDSI	Palmer Drought Severity Index
PPP	projects, programs, and policies, as suggested by the regional water planning steering committees
PWS	public water system *or* public water supplier
RWP	Regional Water Plan
SNOTEL	SNOwpack TELemetry
State Water Plan Act	NMSA 72-14-3.1
USGCRP	United States Global Change Research Program
USIBWC	International Water and Boundary Commission, United States section
USDA	United States Department of Agriculture

List of Acronyms and Definitions (Continued)

USR	underground storage and recovery
UST	underground storage tank
Withdrawal	amount of water diverted from the source of supply
WRRI	New Mexico Water Resources Research Institute

1. Introduction

Water planning in New Mexico involves assessing a diverse and variable water supply throughout the state due to climate variability and the impact on stream flows, declining aquifers, wildfires and ecosystems. Planning also involves assessing population projections and future water demand, infrastructure needs, water quality protection and a multitude of water resource issues brought forth through public involvement. The multiple interstate compacts, the federal government's large involvement and role in water management in certain basins, and many (sometimes competing) water interests create a complex environment for water management in New Mexico.

1.1 PURPOSE OF THE NEW MEXICO STATE WATER PLAN PART II: TECHNICAL REPORT

The *2018 New Mexico State Water Plan Part II: Technical Report* integrates water resource information from the regional water plans (RWPs) completed in 2016-2017 (2016-2017 RWP updates), including estimated water supply and demand, projections of population, and strategies proposed by stakeholders to address key water issues. See Figure 1-1 for a map of New Mexico's 16 water planning regions. This report provides background information about regional water planning, compiles and presents some of the most important data regarding the condition of water resources and expected future demands, looks at the potential supply-demand gap under different scenarios, and summarizes key water issues and strategies developed by steering committees and stakeholders.

1.2 OVERVIEW OF THE TECHNICAL REPORT

A brief history of regional water planning is provided in Section 2 along with a summary of the public involvement in the regional water planning process and for this state water plan. The 2016-2017 RWP updates were written using a consistent methodology, a landmark achievement for the state, enabling the connection between statewide and regional planning scales to be strengthened. Detailed technical information describing methodologies and data used to determine how supply and demand estimates were established throughout the state are explained in Sections 3 through 5 and Appendix 2A.

The second half of this report reflects information developed by regional water planning steering committees and presented in the regional water plans. It summarizes key water resource issues identified by steering committee members and stakeholders throughout the state (Section 6), suggests strategies to improve water resource issues (Section 7), and compiles recommendations to the state to address water resource concerns (Appendix 2B).

1.2.1 Overview of New Mexico's Water Resources

New Mexico water resources consist of five major and three small river basins (Figure 1-2) and multiple groundwater basins. The eight river basins cross interstate boundaries, requiring interstate compacts approved by Congress, which apportion each basins' water between New Mexico and the other states within the basins. These compacts require New Mexico to administer surface and groundwater supplies for each basin to ensure compliance with their respective compact obligations. Additionally, the United States has entered into two international treaties with Mexico, which apportion the waters of those basins between the two countries.

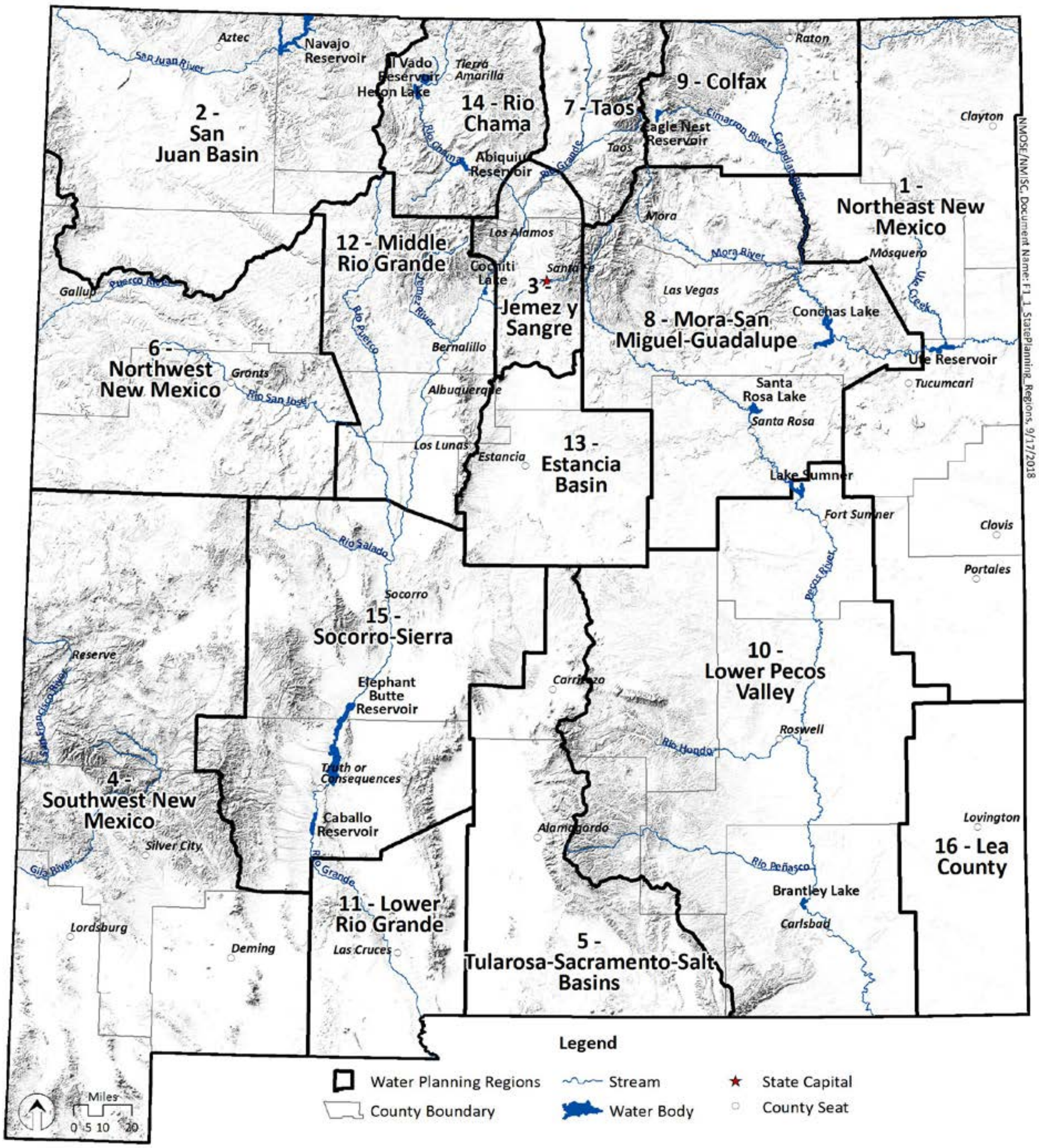
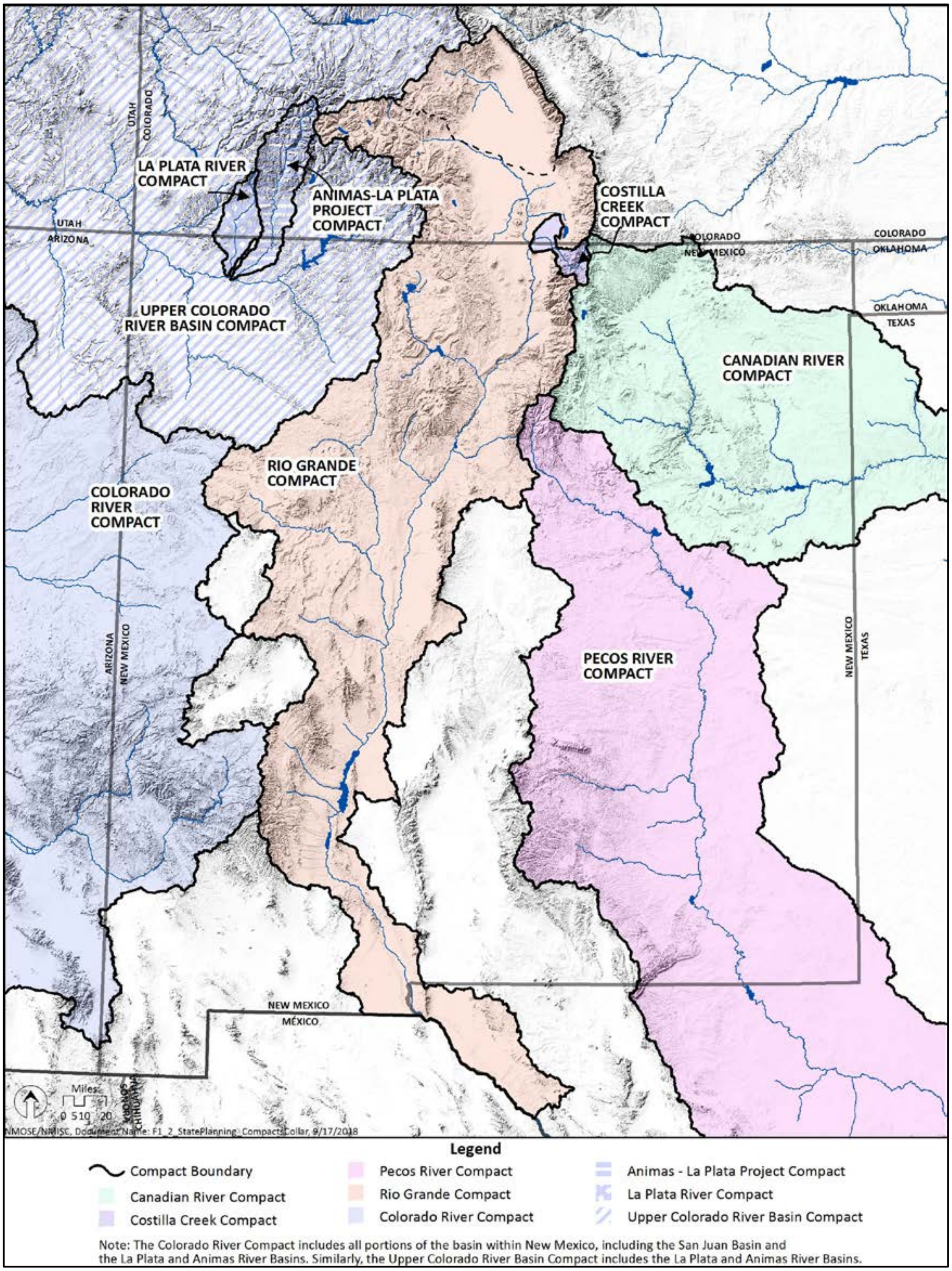


Figure 1-1. Water Planning Regions in New Mexico.



Office of the State Engineer
Interstate Stream Commission

Figure 1-2. Interstate Compacts with Neighboring States.

The Federal Government is also involved in the management of surface water in certain stream basins, particularly where endangered species habitat or other federal interests are affected. These interests include fulfillment of the Federal Government's trust responsibility to tribes. Certain interstate compacts (for instance, the Rio Grande Compact) include a provision that nothing in the compact can affect the obligations of the Federal government to the tribes or impair the rights of the tribes. The *Part III: Legal Landmarks* summarizes the legal landmarks involved in administering the state's river basins and groundwater resources statewide.

1.2.2 Analyzing Supply and Demand

Water planning relies heavily on estimates of supply and demand, and projections of future gaps between supply and demand. Each irrigation district, public water system, mining operation, or other water provider works to identify their water system needs and project future water demand. The supply and demand estimates for an individual water system are often based on water rights and numerical models of sustainability for that system. But each water system is rarely isolated and is often diverting from a river system or pumping from the same aquifer system with multiple users.

Supply. While it may seem straightforward to quantify supply, the task is challenged not only with seasonal and yearly variability, but also by location. The surface water budget on a stream varies depending on numerous factors including proximity to headwaters, tributary inflows, return flows, spring flows, and reservoir storage. The surface and groundwater supplies may be reduced in the future due to delayed impacts from pumping that have yet to reach stream systems, though these projections would require more sophisticated techniques than presented in this report.

Demand. Demand may fluctuate with population, but also according to economic growth factors, such as the boom and bust cycles of the oil and gas industry. Other challenges in estimating demand can stem from water rights because not all water rights in the state are adjudicated, which limits the ability to quantify the potential demand on water resources. Depicting the water demands on river flow downstream of a region due to legal obligations, such as an interstate compact, is particularly problematic when those obligations are continuously changing and dependent on multiple variables, such as stream flow at a particular upstream gage, volume of water in storage, and volume of storm flows.

Water demands from non-human water uses, such as riparian evapotranspiration, is not explicitly quantified in this report and is projected to increase with warming temperatures and extended growing seasons as our climate continues to warm due to greenhouse gas emissions. Finally, demand estimates are based in part on metered water use, for those water use categories that report meter readings (such as public water systems), but many water uses are not metered and the New Mexico Office of the State Engineer (OSE) relies on United States Department of Agriculture (USDA) estimates of crop acreage and consumptive irrigation requirements to estimate the water use.

Supply-Demand Gap. Gaps between supply and demand may be predicted for different regions by considering the difference between projected supply and projected demand. Of course, many factors influence supply and demand, though certain factors are known to have a high level of influence, such as the amount of precipitation in a year, changes in population, and changes in agriculture or industry. Regional or statewide summaries of the supply-demand gap may not reflect the actual projected gap for an individual water system. One system may have a surplus and another may have a deficit within the same region, thus the regional summary could mask the actual problems facing a particular water system.

The New Mexico Interstate Stream Commission (ISC) is tasked with examining the overall water supply and demand balance to identify and plan for future problems, particularly with meeting interstate compact obligations. Completing this assessment would benefit from better data and numerical modeling of stream and aquifer systems.

The approach utilized in this report to identify supply-demand gaps results in the following conclusions:

- **All** planning regions in New Mexico are projected to have less than 75% of the necessary supply to meet demands in 2060 under the drought scenario.
- **Four** of those regions are projected to have less than **20%** of the necessary supply under the drought scenario.
- The **Northeast New Mexico** planning region is projected to have about 26% of the supply needed to meet 2060 demands under **average** water supply conditions due to the rapid depletion of the Ogallala/High Plains aquifer.

1.2.3 Key Issues and Recommendations

The 16 RWPs contained information about the key issues impacting their region. These key issues were compiled and summarized to provide an overall status of the issues facing the state. The number one issue, not surprisingly, is insufficient water supply, followed by vulnerability to climate, water management, the need for a better understanding of water resources, water quality, and last, but not least, water infrastructure and maintenance. Appendix 2C presents several strategies for reducing the supply-demand gap such as specific ideas for conservation across multiple water use categories and methods of developing new supplies.

As part of the process for developing the regional water plan, stakeholders were asked to submit their projects, programs, and policies (PPP) lists to assist the state in assessing the statewide infrastructure needs and opportunities for collaboration. Over 2,600 PPPs were compiled and summarized according to categories based on the objective (such as increase supply, reduce demand, protect supply, improve efficiency, or prepare for drought). Finally, the regional stakeholders were asked to provide recommendations to the state for improving water resource management. The key issues, PPPs and recommendations to the state helped inform the policy topics presented in *Part I: Policies*.

1.2.4 New Mexico's 16 Regional Water Plans

This *2018 New Mexico State Water Plan Part II: Technical Report* relied heavily on the thorough documentation of water demand and supply from the 16 RWPs.

Without the participation of the regional steering committees and the members of the public, the task of regional water planning would not have been possible. The most recent updates of the 16 RWPs completed in 2016 and 2017 have provided a solid foundation for future revisions and improvements. The 16 New Mexico RPWs are listed and linked below.

Region 1	Northeast New Mexico
Region 2	San Juan Basin
Region 3	Jemez y Sangre
Region 4	Southwest New Mexico
Region 5	Tularosa-Sacramento-Salt Basins
Region 6	Northwest New Mexico
Region 7	Taos
Region 8	Mora-San Miguel-Guadalupe
Region 9	Colfax
Region 10	Lower Pecos Valley
Region 11	Lower Rio Grande
Region 12	Middle Rio Grande
Region 13	Estancia Basin
Region 14	Rio Chama
Region 15	Socorro-Sierra
Region 16	Lea County

2. Brief History of Regional Water Planning History and Public Involvement Process

The boundaries of the 16 water planning regions follow some watershed boundaries and government borders, such as counties or Council of Governments (COG) boundaries, and vary in size, ranging from 2,262 (Taos planning region) to 17,337 (Southwest planning region) square miles. Each region has unique water resource issues based on the demographics, history, land use activities (including commercial and industrial development), and variability of water resources.

2.1 HISTORY OF REGIONAL WATER PLANNING

Regional Water Planning in New Mexico began in earnest in 1987, when the New Mexico legislature authorized the ISC to provide loans and grants for regional water planning activities. Jurisdictions seeking funding, whether a county, city, water board, or water commission, could define their planning region for their proposed planning study.

Thus, through the process of seeking funding, the water planning boundaries began to emerge, originating from the ground up, and not through a statewide analysis or comprehensive approach. Several iterations of water planning regions developed, but since 1996, the 16 regions shown in Figure 1-1 have remained essentially the same (New Mexico Water Dialogue, 1996). The regional water planning boundaries remain problematic due to the tension between representing hydrologic (watershed) boundaries for ease of calculating water budgets versus administrative boundaries to facilitate participation and leadership of the planning process. A white paper (ISC, 2017a) describes some of the conflicts presented by the current boundaries.

ISC reached out to regional water planners with a survey about the water planning boundaries in 2017 (ISC, 2017b) and found that balancing supply and demand in their region was the greatest motivating factor in participating (at 37% of the survey responses), followed by job requirement at 23% and interest in planning (21%). Time commitment was the greatest reason for limiting participation. Having hydrologic boundaries that facilitate accurate calculations was most important to 75% of the responders of the survey, compared to 14% that wanted convenient meeting locations and 11% that desired political boundaries.

In the early stages of regional water planning (1990s), the regions retained consultants to address the components and requirements of the *Regional Water Planning Handboo*k (the “1994 Handbook”) (ISC, 1994). Documents related to the first phase of water plans are available on the ISC’s website (ISC, 2018) and provide a detailed summary of the water supply issues of each region. Each water plan developed a different approach to assessing water supply and demand, making compilation of the data into a state plan challenging.

To address this issue, ISC developed the *Updated Regional Water Planning Handbook: Guidelines to Preparing Updates to New Mexico Regional Water Plans* in 2013 (the “2013 Handbook”) (ISC, 2013). The technical information for each of the 16 regions followed a common technical approach so that the information could be synthesized into a state water plan.

2.2 PUBLIC INVOLVEMENT IN THE WATER PLANNING PROCESS

In concert with the compilation of technical data, the ISC with support from various contractors coordinated the reconvening of existing (but inactive) as well as new steering committees in each of the regions, which occurred between 2014 and 2017. Some regions already had long-established water planning groups and the ISC asked these groups if they would be involved in the process to update the RWPs.

Each steering committee was comprised of local and regional stakeholders and organizations, such as regional COGs, water providers, agricultural districts and acequias, elected officials, active water planning councils, local, state, federal, and non-government technical advisors and other water interests. Steering committees represent the different water user groups identified in the 2013 Handbook and have the associated water management expertise and experience. Thus, the 2016-2017 RWP updates involved participation by a representative group of stakeholders within each region (see Figure 2-1).

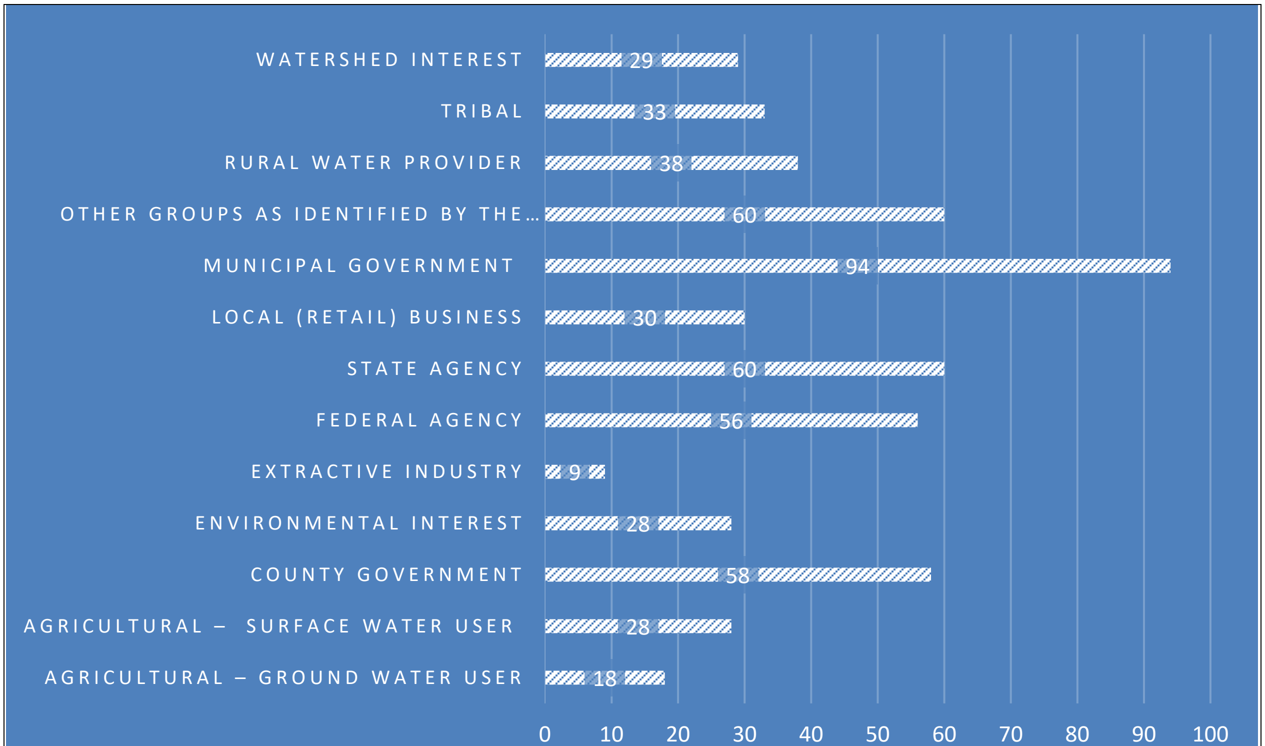


Figure 2-1. Number of Stakeholders Represented on Steering Committees Statewide.

The regional steering committees provided feedback on the technical information and developed lists of PPPs (projects, programs, and policies) and recommendations to the state for improving water management in New Mexico. The "Public Involvement in the Planning Process" chapter in each of the 2016-2017 RWPs documents the public planning process used to update the plans and lists strategies for future public involvement. The plans contain details about the committees' formation, membership, and meetings; such as dates, locations, agendas, and summaries. All the RWPs are available on the ISC Planning web pages (ISC, 2018).

Throughout the regional planning update process, all meetings were open to the public. The ISC supported regional steering committees by preparing agendas for meetings, facilitating meetings, assisting with outreach, providing data, and keeping records of all the meetings. During the planning process, the ISC and the steering committees worked together to update the regional water plans. The ISC provided the regions with technical sections of the plan and the steering committees developed their strategies for addressing future water challenges.

2.3 PUBLIC INVOLVEMENT IN THE STATE WATER PLAN

The ISC recognizes the significant and central role water plays in communities, cultures, the environment and economy of the state and worked to involve as many diverse stakeholders as possible to engage in important and relevant public meetings and conversations about people's values and ideas regarding water issues. The public involvement process for the State Water Plan was built on the thorough public involvement activities conducted in the regional water planning process. That planning process included a significant emphasis on public involvement to reach a broad range of stakeholders to solicit their feedback about regional water planning issues, strategies and projects, programs and policies. The regional water planning steering committees convened many times, as well as conducted their own public outreach initiatives. Building on this momentum, the ISC collaboratively organized a statewide public involvement event focused on the State Water Plan and encouraged broad participation. The ISC hired New Mexico First to facilitate a State Water Planning Town Hall. 225 people registered for this two-day event hosted in December 2017 in Albuquerque.

What makes a Town Hall different than public meetings or conferences with multiple presentations is that the event is comprised of small group discussions among people who care about water issues in New Mexico and want to create recommendations that will lead to action. During the event, participants engaged in discussions focused on six water planning topics and worked together to create draft and then final recommendations for consideration in the development of the State Water Plan. New Mexico First then compiled a report summarizing the event and the proposed recommendations (NMF, 2018). The ISC reviewed and incorporated these recommendations to create the eight water policy topics, goals, and strategies in the *Part I: Policies.*

The Regional Water Plans also significantly influenced the policies in the State Water Plan. Specifically, the key water issues, the PPPs, and the recommendations from the steering committees to the state were used to craft the framework for the policies.

The ISC released the *Draft 2018 New Mexico State Water Plan* for public comment from July 9 through August 25, 2018. At this time, the ISC issued a press release and the ISC Water Planning Program Manager distributed multiple mass emails to water planning stakeholders, inviting the public to submit comments on the draft plan through a website specifically created for this purpose or to submit written comments via the mail. Approximately 80 different governmental and non-governmental organizations and individuals submitted comments on the draft plan.

The ISC reviewed and addressed meaningful public comments as part of the process of finalizing the plan. The ISC is grateful to the many stakeholders who submitted comments which helped strengthen and improve the plan. These comments and the draft plan are posted on the ISC's State Water Plan web page (ISC, 2018).

2.4 CONSULTATION WITH NATIONS, TRIBES, AND PUEBLOS

The nations, tribes, and pueblos in New Mexico are sovereign governments that assert authority and responsibility over water use and water quality within their territories. The nations, tribes, and pueblos in New Mexico highly value water and are deeply connected to water though ancient custom and traditions that are passed from generation to generation. The state of New Mexico recognizes the importance of passing on sacred values and will respect traditional, cultural, and religious values and uses of water by nations, tribes, and pueblos in the planning process and in the government-to-government consultations.

The ISC, in collaboration with the OSE, invited all of the nations, tribes, and pueblos in New Mexico to engage in these consultations. Letters were sent to 23 sovereign governments inviting input. The New Mexico State Engineer, as well as representatives of the Water Planning Program of the ISC, have been honored to engage in such consultations. They have met with governors, tribal council members, and staff of many of the nations, tribes, and pueblos to discuss a variety of matters, including this *2018 New Mexico State Water Plan.*

3. Water Supply

New Mexico's water supply is highly variable throughout the state and is affected by climatic conditions as discussed in Section 3.1. The state's water supply includes both surface water supplies (Section 3.2), originating primarily in the higher mountain areas; and groundwater resources that are most extensive in eastern, southwestern, and the central valleys of New Mexico; with lesser resources throughout the rest of the state (Section 3.2). Regional surface water and groundwater use, which developed because of the relative availability of each resource around the state, is illustrated in Figure 3-1. While 2010 was an "average" water supply year, in dryer years, the percent of groundwater use increases relative to surface water.

The northern part of the state (including the San Juan, Upper Rio Chama and the Canadian basins) has minimal groundwater resources, but ample surface water in non-drought years. Groundwater in these basins is primarily found in the shallow alluvium adjacent to surface water. The regions along the Rio Grande and the Pecos River rely on surface water and have groundwater resources to meet a significant portion of the water demand. The far eastern portion of the state and the Estancia Basin rely entirely on groundwater from aquifers that are diminishing.

The surface water/groundwater distribution as illustrated in Figure 3-1 is expected to shift by 2030 (when the Eastern New Mexico Rural Water Supply Project/Ute Reservoir Pipeline Project brings in surface water supplies to some communities in eastern New Mexico, where groundwater supplies are rapidly diminishing, and the Navajo-Gallup Water Supply Project delivers additional surface water to northwestern New Mexico).

Planning regions of the state that rely primarily on surface water (Figure 3-1) include the Colfax, Mora-San Miguel-Guadalupe, Rio Chama, and San Juan Basin, which receive more than 90% of their supply from surface water. These regions are particularly vulnerable to drought and do not have widespread abundant alternative groundwater supplies, although the San Juan Basin planning region benefits from more plentiful reservoir storage. Other regions with significant surface water use (60 to 80%) include Jemez y Sangre, Lower Rio Grande, Middle Rio Grande, Socorro-Sierra, and Taos; these regions also are vulnerable to drought, as are sub-areas within other regions.

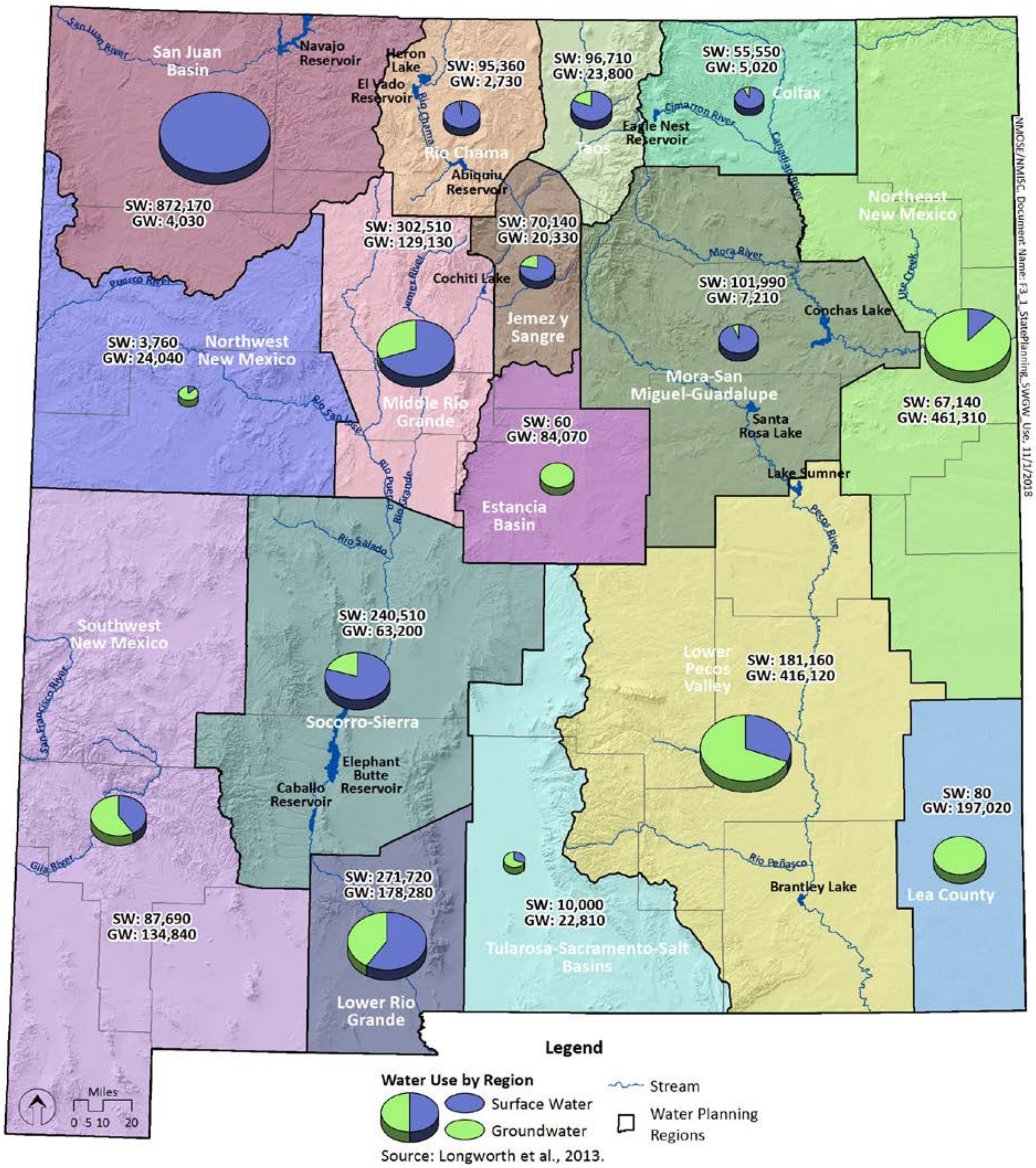


Figure 3-1. Surface Water and Groundwater Use in New Mexico Water Planning Regions in 2010.

3.1 CLIMATE OF NEW MEXICO

3.1.1 Precipitation and Evaporation

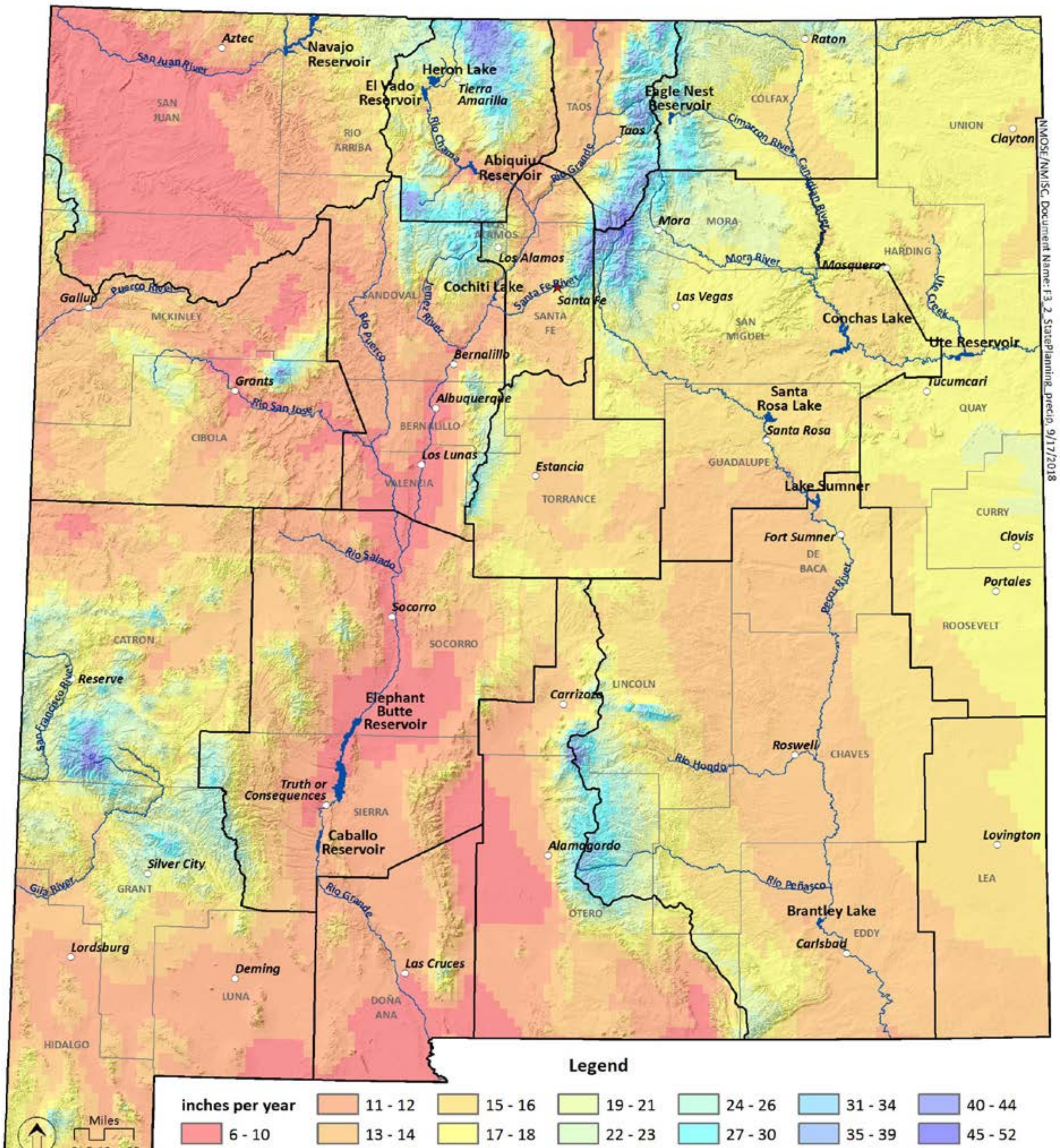
Except for its high mountains, New Mexico's climate is arid to semi-arid; and thus, precipitation is on average very low and highly variable. Figure 3-2 shows the average annual precipitation across New Mexico from 1980-2010 (a relatively wet period). In the lowest elevations, annual precipitation is much lower than the mountainous areas.

Figure 3-3 shows the gross annual lake evaporation, which is almost the inverse of the precipitation map: greater evaporation potential at lower (and hotter) elevations and less evaporation at the higher (and cooler) elevations. Gross lake evaporation represents the annual evaporation that would occur from a free water surface (a standing body of water such as a lake or reservoir).

The RWPs each summarized general climate patterns and the variability of temperature and precipitation at representative climate stations. Those regions with higher elevations and snowpack also included data from Natural Resources Conservation Service (NRCS) snow course and/or snowpack telemetry (SNOTEL) stations.

A significant portion of New Mexico's surface water and recharge to aquifers is derived from winter precipitation. The snowpack analyzed from the RWPs illustrated considerable variability over time, with high precipitation years showing considerably greater precipitation than drought years. Summer thunderstorms, also a highly variable source of supply, contribute a significant portion of runoff and recharge to many areas of the state.

Figure 3-4 shows the extent of snowpack in April for a wet year (2005), average year (2010) and a dry year (2018) illustrating the recent variability of this important water supply.



Source data: PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, created 2 Feb 2018.

Figure 3-2. Average Annual Precipitation (inches) in New Mexico (average for 1981-2010).

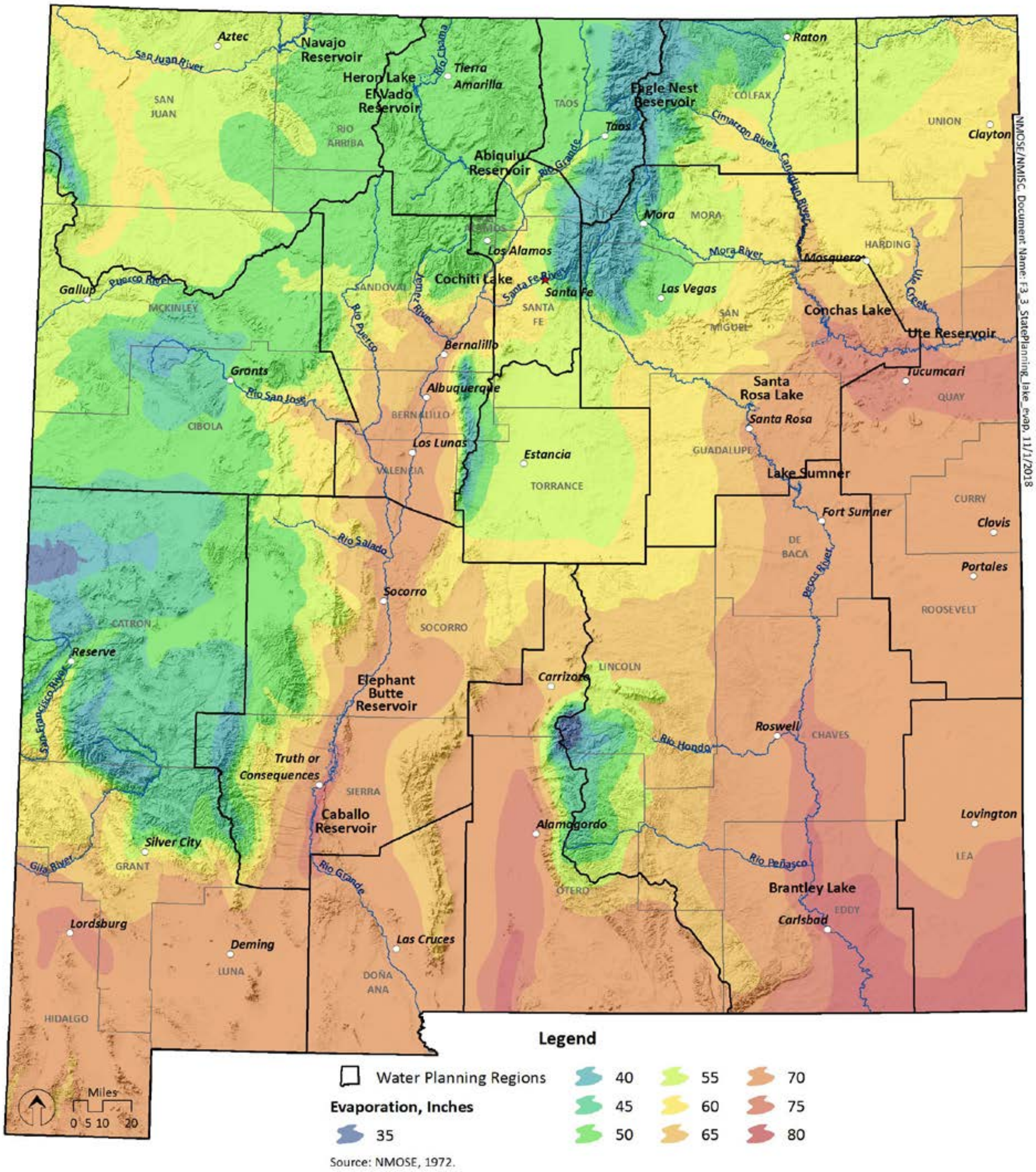
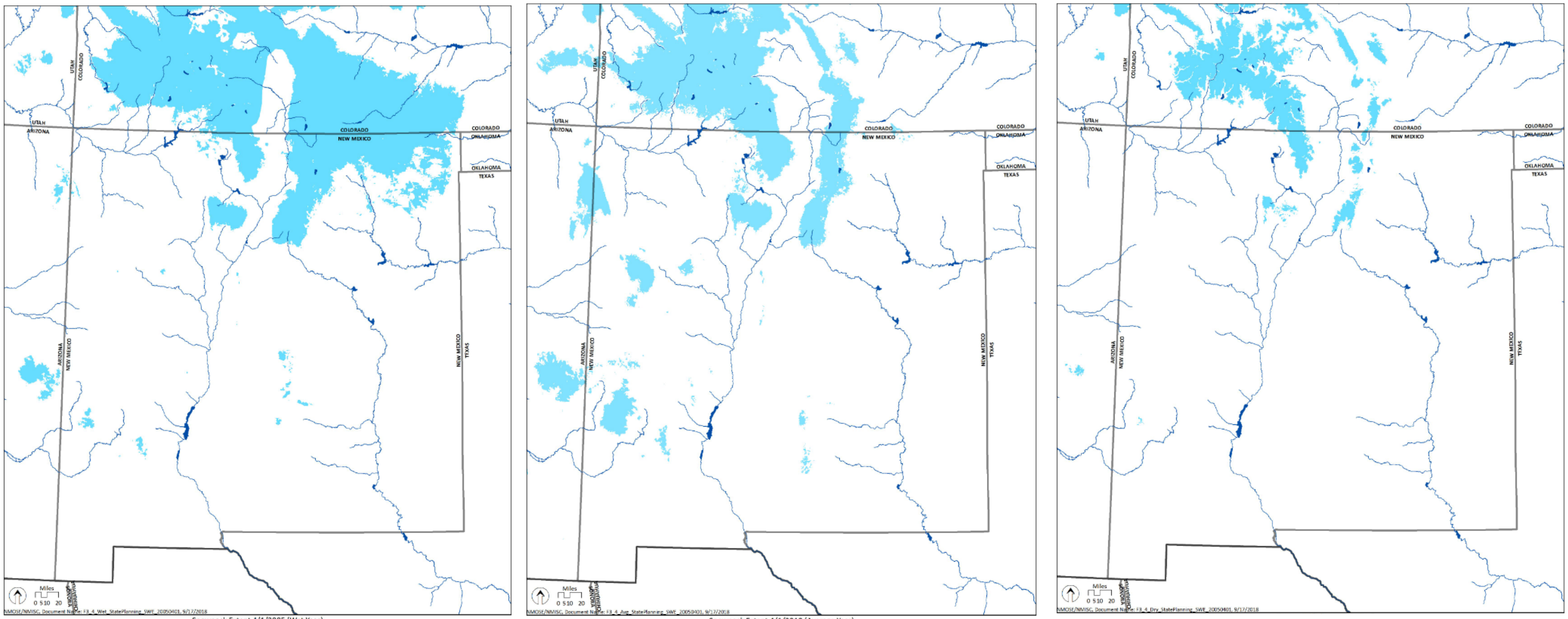


Figure 3-3. Gross Annual Lake Evaporation.



Wet (2005) | Average (2010) | Dry (2018)

Sources: National Operational Hydrologic Remote Sensing Center. 2004. Snow Data Assimilation System (SNODAS) Data Products at NSIDC, Version 1. SWE. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. doi: https://doi.org/10.7265/N5TB14TC. [May 2018].

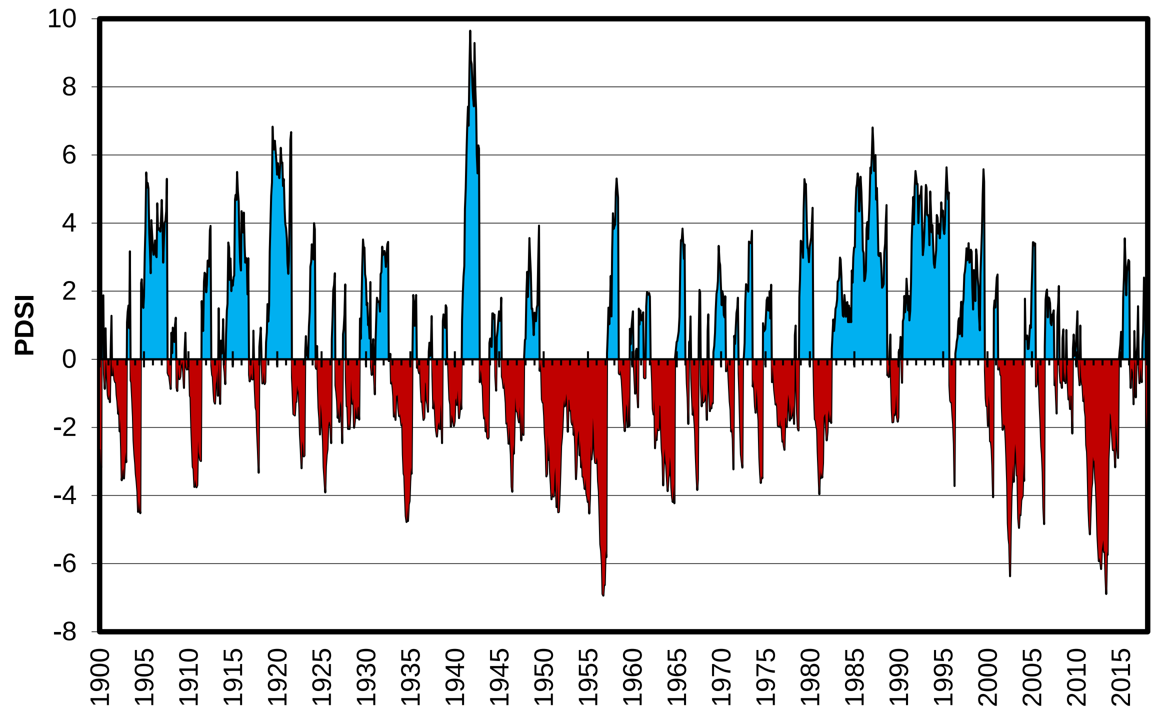
Office of the State Engineer NM Interstate Stream Commission

Figure 3-4. Snowpack on April 1 for a Wet (2005), Average (2010), and Dry (2018) Year.

3.1.2 Climate Variability and Drought

The RWPs also summarized long-term drought records based on the Palmer Drought Severity Index (PDSI). The PDSI is a drought index (a ranking system) derived from the assimilation of data—including rainfall, snowpack, stream flow, and other water supply indicators—for a given area. Long-term PDSI records are available for eight climate divisions in New Mexico, and these records were presented in each of the RWPs.

The variability of this drought index for a Northern New Mexico climate division is illustrated in Figure 3-5; a map of the climate divisions is included in Appendix 2A. The PDSI graph for the seven other climate divisions show the same trends with some local variations.



Notes:
Drought periods indicated in red; above average precipitation indicated in blue.

Figure 3-5. Palmer Drought Severity Index for New Mexico Climate Division 2 in Northern New Mexico.

As indicated by the variable PDSI, New Mexico's climate has historically exhibited a high range of variability. Periods of extended drought, interspersed with relatively short-term, wetter periods are common. Historical periods of high temperature and low precipitation have resulted in high demands for irrigation water and higher open-water evaporation and riparian evapotranspiration.

While much of New Mexico's surface water in the San Juan River and Rio Grande originated in the mountains of southern Colorado, the local PDSI is based on local precipitation and temperature, thus the local PDSI is not necessarily representative of the local water supply. Furthermore, the historical PDSI illustrated for the period of record in Figure 3-5 is likely to show a downward trend in the future, as discussed in Section 3.1.3. The recent 30 to 40 years has been wetter than the 117-year period presented in Figure 3-5.

3.1.3 Climate Change

In addition to natural climatic cycles that affect precipitation patterns in the southwestern United States (i.e., El Niño/La Niña, Pacific Decadal Oscillation, Atlantic Multidecadal Oscillation, and the North American Monsoon), the considerable recent research on potential climate change scenarios and their potential impact on the southwestern United States, including New Mexico must be considered.

The consensus on global climate conditions is represented internationally by the work of the Intergovernmental Panel on Climate Change (IPCC), whose Fifth Assessment Report, released in September 2013, states, "Warming of the climate system is unequivocal, and since the 1950s many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased" (IPCC, 2013).

Atmospheric concentrations of greenhouse gases are rising so quickly that all current climate models project significant warming trends over continental areas in the 21st century. The most recent IPCC special report (IPCC, 2018) confirmed that human activities have caused approximately 1.0 degrees Celsius (°C) of global warming above pre-industrial levels and that warming is likely to reach 1.5 °C between 2030 and 2052 with the current rate of emissions.

In the United States, regional assessments conducted by the United States Global Change Research Program (USGCRP) have found that temperatures in the southwestern United States have increased and are predicted to continue to increase, and serious water supply challenges are expected. Water supplies are projected to become increasingly scarce, calling for trade-offs among competing uses and potentially leading to conflict (USGCRP, 2014). Most of the major river systems in the southwestern United States are expected to experience reductions in streamflow and other limitations to water availability (Garfin et al., 2013).

Although there is consensus among climate scientists that global temperatures are warming, there is considerable uncertainty regarding the specific spatial and temporal impacts that can be expected. To assess climate trends in New Mexico, the OSE and ISC conducted a study in 2006 of observed climate conditions over the past century and found that observed wintertime average temperatures had increased statewide by about 1.5 degrees Fahrenheit (°F) since the 1950s. Several studies predict temperature increases in New Mexico from 5 °F to 10 °F by the end of the century (Forest Stewards Guild, 2008; Hurd and Coonrod, 2008; USBOR, 2011).

Predictions of annual precipitation are subject to greater uncertainty, particularly regarding precipitation during the summer monsoon season in the southwestern United States (OSE and ISC, 2006). In parts of the state snowpack is expected to be lower and snowmelt is expected to be earlier (Gutzler, 2003; Gori et al., 2014). Based on these studies, the effects of climate change that are likely to occur in New Mexico and the planning regions include (OSE and ISC, 2006):

- Temperature is expected to continue to rise.
- Higher temperatures will result in a longer and warmer growing season, resulting in increased water demand on irrigated lands and increased evapotranspiration from riparian and forested areas, grasslands, and forests, and thus less recharge to aquifers.
- Reservoir and other open-water evaporation is expected to increase. Soil evaporation is also expected to increase.
- Precipitation is expected to be more concentrated and intense, leading to increased projected frequency and severity of flooding.
- Stream flows in major rivers across the American Southwest, including New Mexico, are projected to decrease substantially during this century (e.g., Christensen et al., 2004; Hurd and Coonrod, 2008; USBOR, 2011, 2013) due to a combination of diminished cold season snowpack in headwaters regions and higher evapotranspiration in the warm season. The seasonal distribution of stream flow is projected to change as well. Flows could be somewhat higher than at present in late winter, but peak runoff will occur earlier and be diminished. Late

spring/early summer flows are projected to be much lower than at present, given the combined effects of less snow, earlier melting, and higher evaporation rates after snowmelt.

Forest habitat is vulnerable to both decreases in cold-season precipitation and increases in warm-season vapor pressure deficit (Williams et al., 2010; Williams et al., 2013). Stress from either of these factors leave forests increasingly susceptible to insects, forest fires, and desiccation. Greater temperatures also increase insect survivability and fire risk.

Climate change will have a significant impact on New Mexico's water resources, forests, and infrastructure. The projected decline in surface water supplies will undoubtedly result in greater reliance on limited groundwater resources. New Mexico and Colorado's forested lands, the primary source of much of our water supply, will be subjected to increasing potential for catastrophic forest fires and the debris flows that can follow high intensity rainfall events.

As discussed in Sections 6 and 7, many of the key issues and proposed strategies are in response to these projected changes. New Mexicans have a keen interest in expanding the knowledge of groundwater resources and exploring new potential sources through desalination. For several decades, New Mexicans have been implementing forest treatments and restoration strategies to improve the resilience of the landscape to forest fire, droughts, and flooding. A better understanding of the statewide condition of New Mexico's forests and the vulnerability of infrastructure to flooding and debris flows from extreme precipitation events is a universal desire from all regions.

3.2 SURFACE WATER

The major river basins located in New Mexico include the San Juan, Rio Grande, Pecos, Canadian and Gila. These major river basins, as well as other basins and the annual stream flow in 2010, and the minimum for the available period of record at key gages are shown in Figure 3-6. The greatest volume of surface water in New Mexico is in the Rio Grande and San Juan basins, where flows primarily originate in the mountains of southern Colorado.

Surface water in the state is fully appropriated and the diversion and storage of water is regulated by the OSE to protect senior rights to water, including, where applicable, to ensure that the state of New Mexico is in compliance with its obligations under the interstate compacts to which the state is a signatory.

The regulations generally require that withdrawals and consumptive use be limited or capped or offsets be provided, depending on varying hydrologic conditions.

An important part of surface water supply is reservoir storage, allowing water to be saved during spring snowmelt and periods of high precipitation for later use. Major water supply reservoirs are present in all the major river basins except the Gila River. The RWPs also identified the status of both the larger and smaller dams under state jurisdiction in each region, indicating that 7 out of 297 dams are in unsatisfactory condition and 180 dams around the state are in poor condition (OSE, 2017).

New Mexico's Interstate Compacts

Canadian River Compact

Colorado River Compact

Upper Colorado River Basin Compact

La Plata River Compact

Rio Grande Compact

Costilla Creek Compact

Pecos River Compact

Animas-La Plata Project Compact

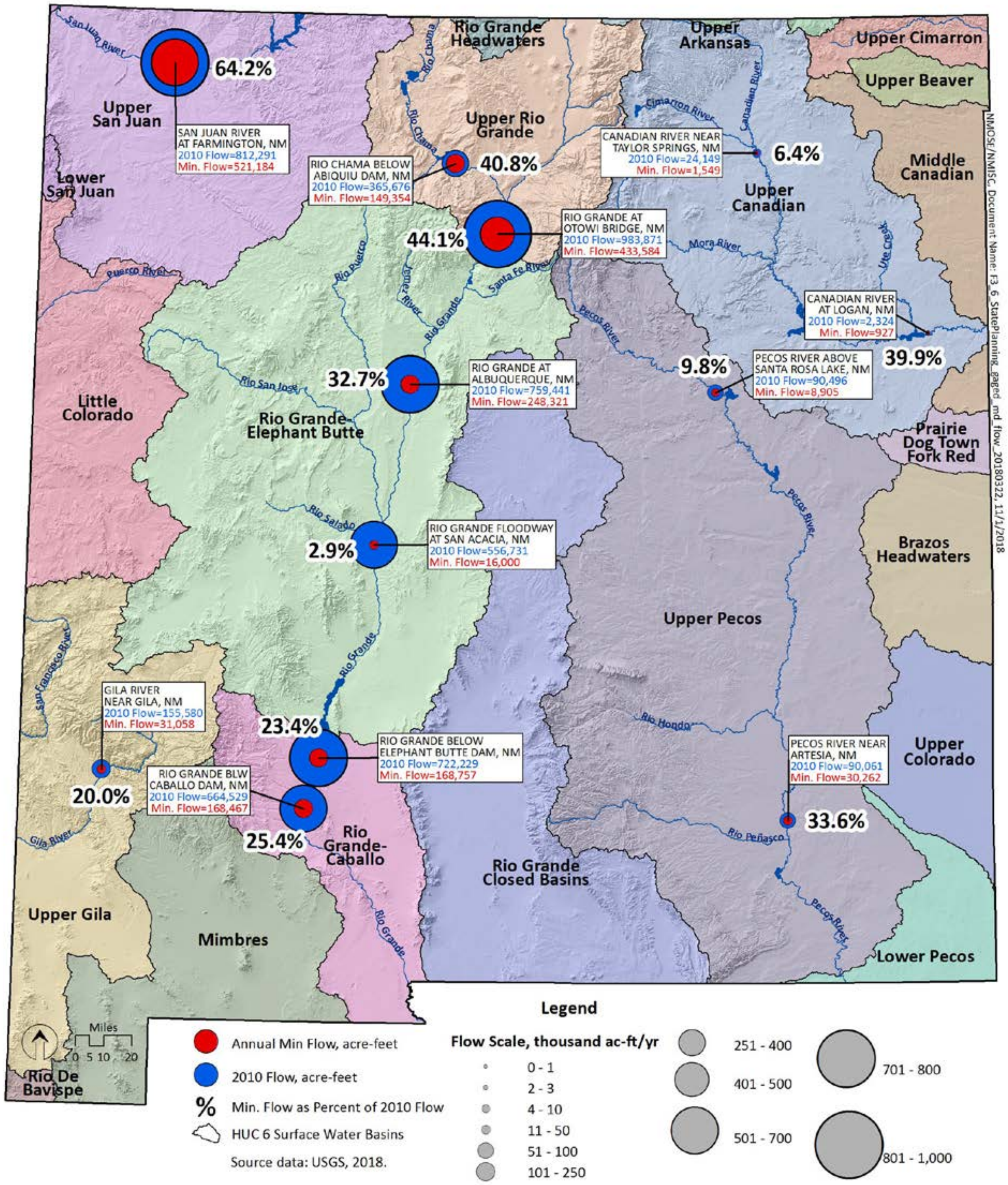


Figure 3-6 Surface Water Basins in New Mexico Showing Flow in 2010 and Minimum Annual Flow at Key Gages for the Available Period of Record.

3.3 GROUNDWATER

Groundwater resources throughout New Mexico vary widely: from conceptually simplistic, bathtub-like basin-fill aquifers of the Ogallala/High Plains in eastern New Mexico, to highly complex and poorly understood water resources in the folded geologic layers and volcanic features of the Ortiz Mountains, to the well-studied shallow and confined aquifers of the Roswell Basin, to practically non-existent groundwater resources in the upper Chama Valley. New Mexico has been a leader in managing groundwater diversions, declaring “groundwater basins” beginning in 1931 with the Mimbres Basin. The New Mexico State Engineer takes jurisdiction over a groundwater basin by "declaring" it; that is, identifying its "reasonably ascertainable boundaries" and stating an intention to administer water within those boundaries (NMSA) §72-12-1). Groundwater basins covering the entire state have been declared, as shown in Figure 3-7. The New Mexico State Engineer administers ground and surface water conjunctively, if there are hydrological connections between them. See *Part III: Legal Landmarks* discussion of City of Albuquerque v. Reynolds, 71 N.M. 428; 379 P.2d 73 (1963) (the State Engineer has authority to recognize administratively the hydrologic connections between ground and surface water).

3.3.1 Sources of Groundwater

Major groundwater resources in New Mexico (depicted in Figure 3-8) include the well-defined formally named aquifers; such as the Ogallala/High Plains, Roswell Basin, Pecos alluvial, Estancia, and Capitan Reef aquifers. The Santa Fe Group and other groundwater resources in the northern, middle, and lower Rio Grande Valley are not clearly defined in all sections and vary greatly in depth, lateral extent, and quality throughout the reach of the Rio Grande. Figure 3-8 shows the various aquifers and declared basins and depicts the extent of the basin fill, but not the saturated thickness of the aquifers. Likewise, the water resources of the Mimbres and other basin and range aquifers in southwestern New Mexico vary from “closed” to “stream-connected,” and the extent of the resources in those basins is poorly understood. The water quality in closed basins, such as the basin fill in the Tularosa Basin, is generally saline towards the center of the basin and better quality where recharge from the mountain front enters the aquifer. Water in limestone and sandstone formations is variable in both quality and quantity but is generally better quality and more productive than the groundwater obtained from shale formations.

Limited groundwater supplies also occur in some regions that have a low potential to hold water (insufficient pore space in the rock, such as volcanic or crystalline rocks) or poor-quality groundwater resources due to the geologic nature of the rocks (shales and evaporites). Some wells can be drilled to deeper depths; however, local geologic conditions, and/or economic, or water quality issues often limit accessibility to deeper groundwater resources. Some limited aquifers occur in layers of Triassic and Cretaceous sandstone beds in the San Juan Basin and other parts of the state. Such aquifers, particularly those comprised of dipping sandstone beds like the San Juan Basin, are more complicated to map and require three-dimensional depiction.

While the groundwater resources of some portions of the state have been extensively investigated and characterized, such as the Middle Rio Grande Basin near the City of Albuquerque, the resources in large portions of the state are poorly defined or understood. As discussed in sections 6 and 7, the water planning regions are seeking more information about the extent and quality of groundwater resources in the state. The New Mexico Bureau of Geology and Mineral Resources (NMBGMR) has embarked on an aquifer mapping program to address this shortcoming. As studies are completed, the NMBGMR program will provide details about groundwater resources.

Outside of the major groundwater resource areas that are used to supply groundwater for agriculture, municipal and industrial use as well as local domestic supplies, limited groundwater resources are present in most locations. Most of the public water systems (PWSs), including small water systems throughout the state, rely on groundwater. Of the total PWSs in New Mexico, approximately 94% purchase or use groundwater as the primary source of drinking water and supply water to roughly 1,090,000 consumers, or approximately 54% of consumers who receive water from a PWS (NMED, 2016).

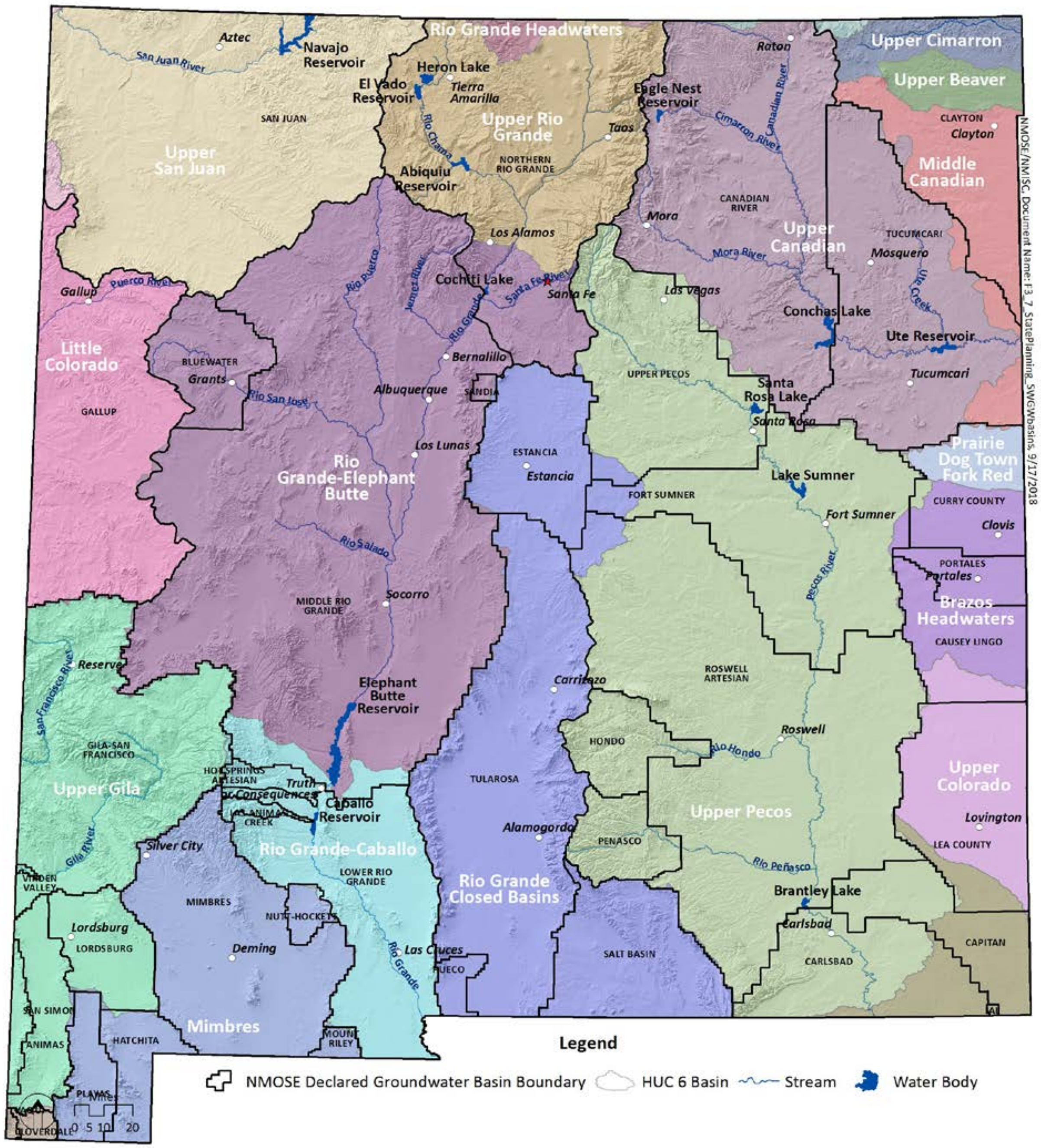
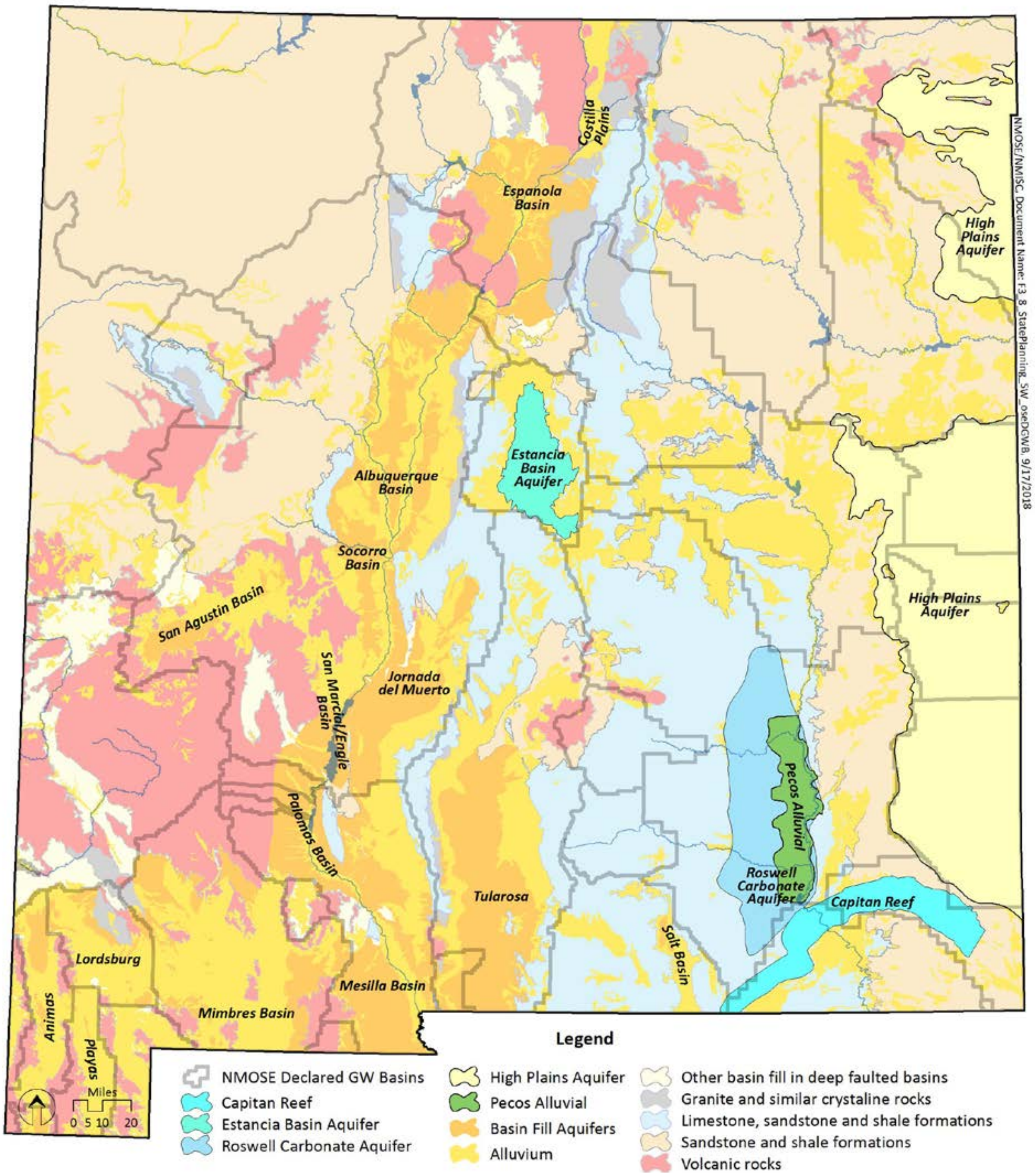


Figure 3-7. Surface Water Basins and Declared Groundwater Basins in New Mexico.



Source: Robson and Banta, 1995, NMBGMR, 2003

Figure 3-8. Declared Groundwater Basins, Geology, and Aquifers in New Mexico.

3.3.2 Declining Groundwater Supplies

In general, groundwater provides a stable and reliable water supply to communities throughout New Mexico; however, in many locations groundwater pumping and other natural discharges exceed recharge, resulting in decline in groundwater levels. In other locations, the pumping is constrained by the OSE so that the effects of the pumping on a stream system are fully offset or constrained to some other degree (set amount per year per well or well system, etc.). Figure 3-9 shows the groundwater basins in New Mexico with declining aquifers (depicted as "select aquifers") where recharge is much less than pumping, resulting in a "mined aquifer."

The OSE has designated Critical Management Areas, also shown on Figure 3-9, to restrict pumping in some aquifers and manage water level declines. Stream-connected aquifers are also declining in some areas as illustrated by the average change in water levels outside of the mined aquifers. Several of the Critical Management Areas are within stream-connected aquifers. Water levels in a stream-connected aquifer may recover much more rapidly than a mined aquifer due to induced recharge from stream losses as a result of groundwater pumping. The future water supply discussed in Section 3.5 was adjusted for the groundwater basins with mined aquifers shown in Figure 3-9.

Some main areas that are affected by declining water levels and by limited alternative water supplies are identified in their respective RWPs. These areas include:

- The Ogallala/High Plains aquifer in the Northeast New Mexico and Lea County planning regions
- Portions of the Northwest planning region (near Gallup)
- Portions of the Estancia Basin planning region
- Portions of the Animas, Playas, Mimbres and other closed basins in the Southwest New Mexico planning region
- Parts of the Jornado del Muerto Basin in the Lower Rio Grande planning region

The most dramatic and problematic groundwater mining is occurring in eastern New Mexico where the Northeast New Mexico and Lea County planning regions are dependent on the Ogallala/High Plains aquifer. Water level declines are greater than 5 feet per year (ft/yr) in the most heavily pumped areas, and the saturated aquifer thickness ranges less than 50 to 150 ft thick. A recent study on the lifetime projections for the Ogallala/High Plains aquifer in east-central New Mexico (Rawling and Rinehart, 2018) concludes that many areas, particularly in southeast Curry and northeast Roosevelt counties, are below the 30-ft threshold of saturated thickness necessary for a viable aquifer, and most of the remaining area has a projected lifetime of less than 10 years. The communities of Clovis and Portales and surrounding areas have fewer than 5 years of remaining supply.

The aquifer in the Estancia Basin is declining at an average rate of 1 ft/yr with an average saturated thickness of about 130 ft. Declining groundwater levels in parts of the Animas, Mimbres, and Nutt Hockett basins (central and southern part of the Southwest New Mexico planning region), due to heavy pumping for municipal and agricultural use, present an issue for long-term sustainability of groundwater resources. However, groundwater level recovery has been observed in some areas where pumping has diminished.

Water level declines have also affected water supply in the Maxwell area of the Colfax planning region, the Ojitos Frios area of the Mora-San Miguel-Guadalupe planning region, the Magdalena area of the Socorro-Sierra planning region, the Santa Fe, Eldorado and La Cienega area of the Jemez y Sangre planning region, portions of the East Mountain area of the Middle Rio Grande planning region, and the Mesilla Bolson of the Lower Rio Grande planning region.

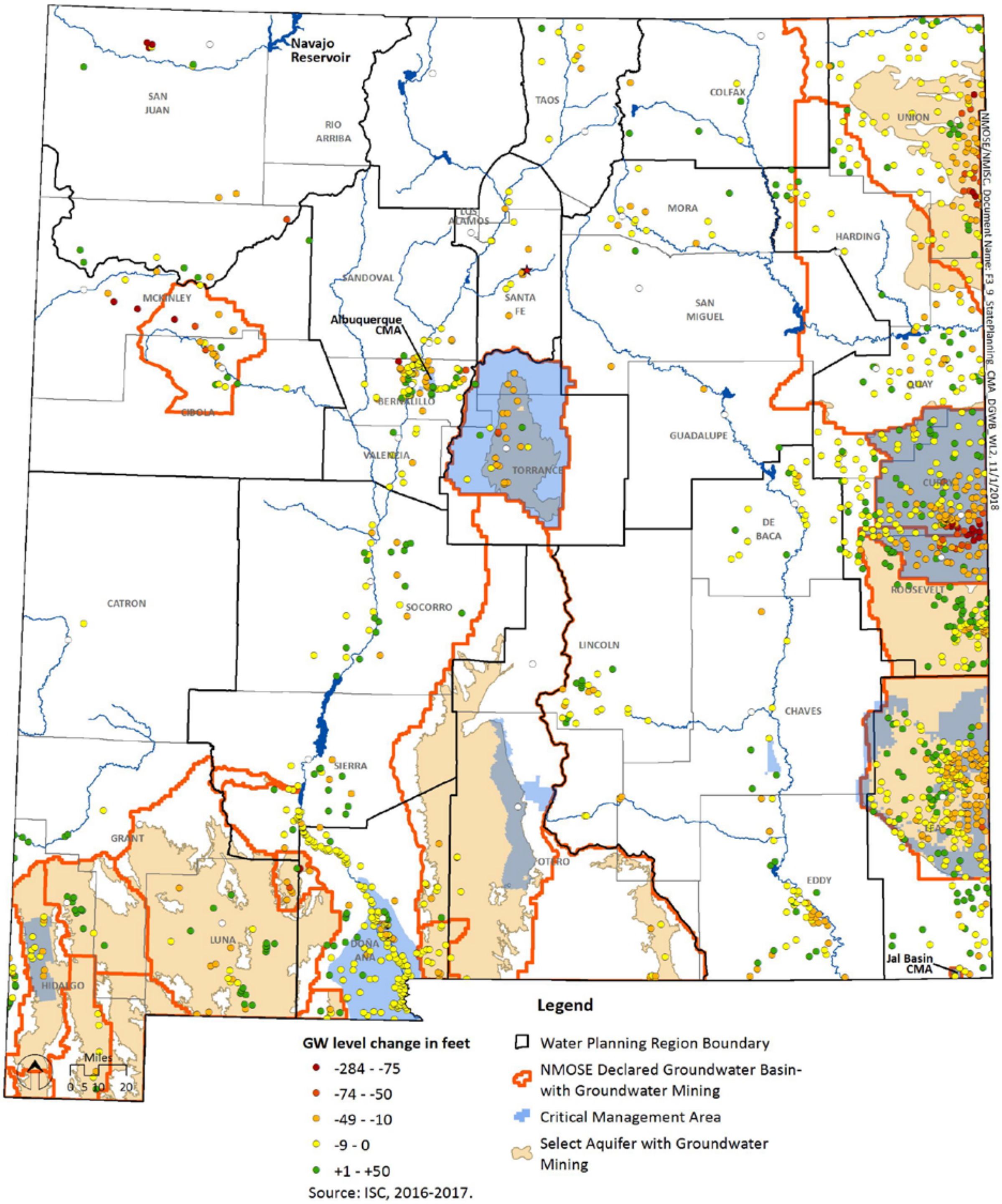


Figure 3-9. Critical Management Areas, Change in Average Water Level (1985-1995 to 2005-2014) and Declared Groundwater Basins with Mined Aquifers.

3.4 DEVELOPING WATER BUDGETS

The State Water Plan Act directs the state to develop water budgets. Though the term 'water budget' is used in different ways, sometimes referring to an amount of water that can be legally used in a defined area or for a particular water system, physical water budgets typically refer to an understanding of the average amount of water originating from various sources (i.e., precipitation, surface runoff, groundwater inflow to streams) and how much water volume is removed from the local system (i.e., evapotranspiration, groundwater withdrawals).

The recently completed RWPs did not attempt to develop water budgets in the traditional sense, but instead focused on the supply which is legally available in an average or “normal” precipitation year (2010) as determined by the estimated amount of withdrawals, as well as drought-corrected supplies to represent a range of planning conditions (see Section 3.5 and 3.6).

The regional water planning boundaries do not lend themselves well to assessing a water budget for each region because many regions overlap watersheds and some communities obtain water from different watersheds and different planning regions. Furthermore, determining the amount of water available for withdrawal and consumption is particularly challenging in the agricultural use category, where much of the water withdrawn by an irrigation district’s diversion structure or by an acequia returns to the stream as “waste” or “loss” (subsurface seepage return flow to the stream) which is rediverted by a downstream diversion within the same irrigation district or a downstream acequia. Thus, the water diverted by the agricultural use category (80% of the total withdrawals in New Mexico) likely includes water that is rediverted many times. And finally, the “water budget” is highly dependent on scale and location. Different water budgets exist at different locations on a stream because the supply and demand vary along a stream reach.

However, one purpose of water planning is to evaluate the sustainability of New Mexico’s water resources, which makes examining the big picture of water supply and demand necessary. A physical water budget was developed by the New Mexico Water Resources Research Institute (WRRI) with funding provided by the New Mexico Legislature (WRRI, 2017). This model could be used in future iterations of water planning to better characterize future water availability, particularly considering predicted increases in temperature that will impact water yield and demand. However, improved estimates of water withdrawals and return flows are needed for future surface-groundwater modeling efforts to adequately estimate water budgets and impacts of climate change on water supplies.

3.5 DESCRIPTION OF ADMINISTRATIVE WATER SUPPLY

To prepare both the RWPs and the State Water Plan, the state developed a set of methods for assessing the available supply and projected demand for “normal” and “drought” supply conditions. As described in the 2013 Handbook (ISC, 2013) a common technical approach was used for RWP updates that were completed in 2016 and 2017. The objective of applying this common technical approach was to be able to efficiently develop a statewide overview of the balance between supply and demand under both normal and drought scenarios, so that the state can effectively plan and fund water projects and programs that will address the state’s pressing water issues.

The method to estimate the available supply, referred to as the ‘administrative water supply,’ is based on withdrawals of water as reported in *New Mexico Water Use by Categories 2010* (Longworth et al., 2013), which provides a measure of supply that considers both physical supply and legal restrictions (i.e., the water is physically available, and its use is in compliance with water rights policies and other legal obligations (such as interstate compacts and treaties) and thus reflects the amount of water available for withdrawal by a region. Considering the actual withdrawals as a measure of supply allows for a reasonable estimate of available water because it discounts physical supplies that may be present in a region but are required by legal or policy restrictions to be conveyed downstream for use. Details of this methodology are more fully discussed in Appendix 2A. The process used in estimation of water use for *New Mexico Water Use by Categories 2010* (Longworth et al., 2013) reasonably captures both tribal and non-tribal water use.

It is recognized that there are several considerations which introduce error into the approximations obtained via the administrative water supply approach. Some of the limitations with the administrative supply approach are discussed in Section 3.5.3. It is not intended to replace or negate the need for more detailed water budgets, models, and other analyses to inform specific projects or local planning decisions.

3.5.1 Estimating Average Supply

The administrative water supply approach provides a reasonable approximation of the average annual water supply available to each planning region. The approach uses withdrawals for 2010, which was a more-or-less average year. These withdrawals, the overall amount of which are administratively capped because the surface water supply (and inter-connected groundwater) in every basin of the state is fully appropriated, provide a reasonably good approximation of each planning region's available average annual water supply.

In parts of the state that rely on groundwater resources, the administrative water supply may not be available in the future where the aquifer is in a non-stream-connected aquifer and the finite resource is diminishing. In these cases, the future available supply was adjusted to account for the estimated decline in water availability in these aquifers.

To estimate the future groundwater supply of closed basins by 2060, groundwater models were used where available, to predict water level declines. For those areas without a groundwater model and for comparison to the model results, the future decline was projected from water level hydrographs and compared to the available water column in existing wells, as described in Appendix 2A.

3.5.2 Estimating Drought-Corrected Supply

An estimate of supply during future droughts was also developed for each region by adjusting the 2010 withdrawal data based on physical supplies available during previous severe droughts. The PDSI, which is an indicator of whether drought conditions exist, and if so, what the relative severity of those conditions is, indicates that for the eight climate divisions present in New Mexico, five were near normal (where the PDSI is near to zero) and three were in incipient wet spells. Given that the water use data for 2010 represent a near-normal to slightly-wetter-than-normal year, it cannot be assumed that the average supply will be available in all years. In fact, half of the years will be drier than the "normal" water supply year. Thus, it is important to also consider potential water supplies during severe drought conditions.

There is no established method or single correct way of quantifying the water supply available during severe drought conditions, given the complexity associated with varying levels of drought and constantly fluctuating water supplies. For purposes of having an estimate of the water supply available during severe drought conditions for regional and statewide water planning, the state developed and applied a method (called a "drought correction") for surface water and for groundwater in regions with both stream-connected and non-stream-connected aquifers.

The drought-corrected surface water supply is based on a review of historical stream gage records, as detailed in Appendix 2A. The minimum annual yield for key stream gages on mainstem drainages was compared to the 2010 yield, and the gage with the lowest ratio of minimum annual yield to the 2010 yield was selected to reflect the supply during a drought.

In non-stream-connected, or closed, basins, the administrative water supply was adjusted to consider potential long-term severe drought impacts on groundwater in conjunction with evaluating declines in groundwater levels due to pumping impacts. To estimate the vulnerability of closed basins to a prolonged severe drought within a planning region, groundwater models were used where available to predict the potential impact by 2060 of a drought lasting 20 years (in which no recharge occurred over the 20-year period). For those areas without a groundwater model, the future decline of the saturated thickness relied on an adjustment to the observed decline in water level hydrographs as described in Appendix 2A. In both approaches the predicted water level decline was compared to the available water column in existing wells.

3.5.3 Administrative Supply Limitations

As mentioned earlier, the supply estimates have limitations but provide an approximation of the "average" and "drought" supplies. The drought-corrected surface water supply and both approaches for evaluating groundwater sustainability are simplifications used to obtain an order of magnitude of expected changes in supply. The drought-corrected surface water supply provides a rough estimate of what may be available during a severe to extreme period of drought. The groundwater evaluations also represent an approximation of the impact of severe drought on existing wells by 2060.

Factors to consider when interpreting these results include:

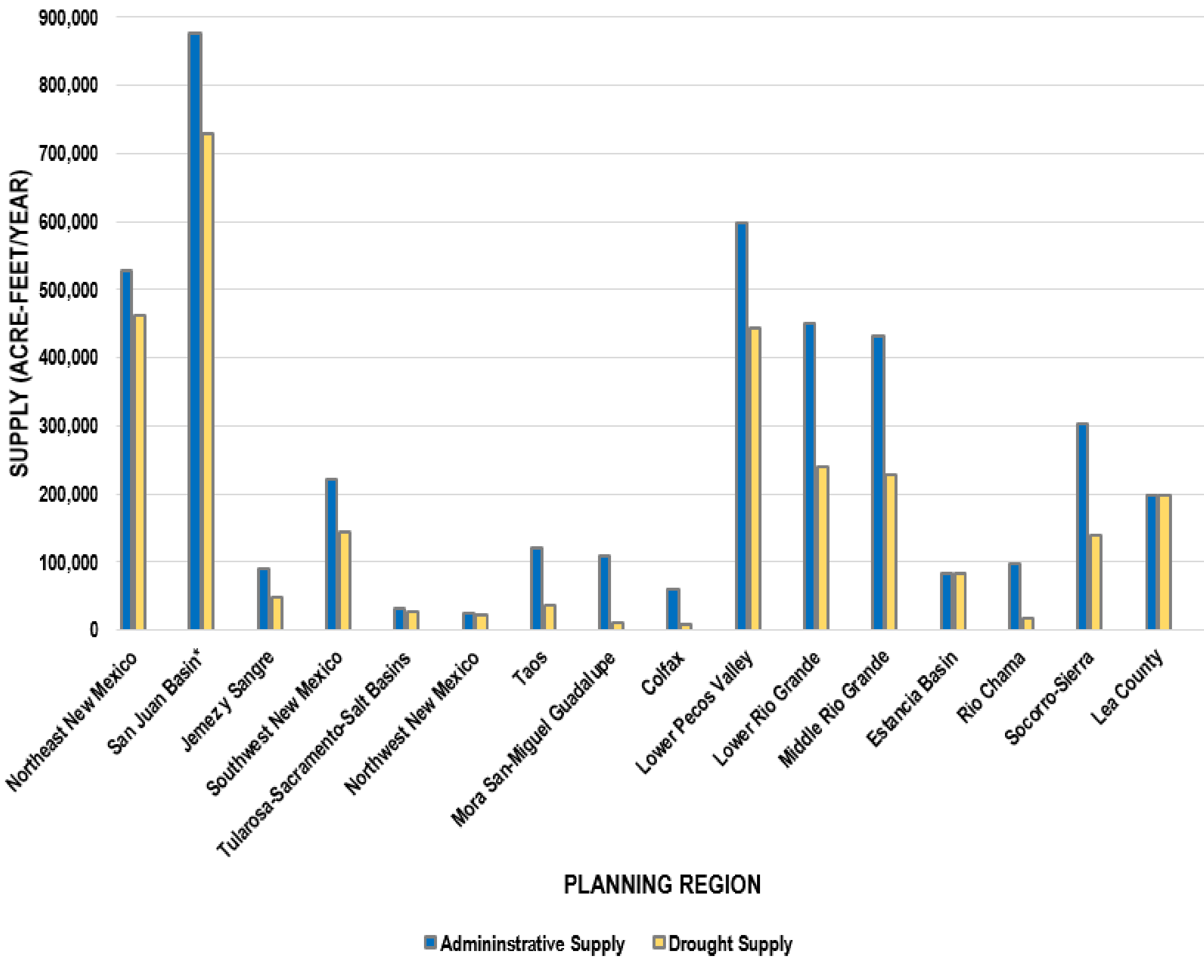
- The water rights held by PWSs for future use and water anticipated to be supplied by authorized but yet-to-be-completed water supply projects was not considered in the 2016-2017 RWP updates, except for the San Juan Basin planning region, which incorporated the Navajo-Gallup Water Supply Pipeline in the administrative supply for that region. Other regional water supply projects that will provide future supply will provide water that was not included in the administrative supply, such as the proposed Ute Pipeline for communities south of Ute Reservoir and San Juan-Chama Project water that has not been put to beneficial use.
- Public institutions, including PWSs, are allowed by statute (NMSA §72-1-9 [40-year plans]) to reserve rights for projected demands 40 years into the future. In response, some communities have planned for development of new supplies in conjunction with retention or acquisition of water rights or project water; and thus, the amount a PWS diverted in 2010 does not necessarily represent the limit of their supply.
- The drought correction developed as part of the common technical approach to reflect limits to surface water supplies may not accurately represent the vulnerability of those PWSs that have developed a conjunctive use strategy. For example, it may appear that a PWS is very vulnerable to drought, when in reality that PWS has a conjunctive use strategy using a portfolio of water sources that allows the PWS to continue to provide water supply, even in severe drought conditions (such as the cities of Albuquerque and Santa Fe).
- Though the drought-corrected surface water adjustment is based on the minimum year of stream flow recorded to date compared to the flow in 2010, it is possible that drought-corrected surface water supplies could be even lower at times in the future.
- Water supplies downstream of reservoirs may be mitigated by reservoir releases in early phases of a severe drought, but longer-term severe droughts may exhaust those storage supplies and have potentially much more significant consequences and socioeconomic impacts.
- In some parts of the state, particularly in some of the larger planning regions, surface water irrigators are far removed from developed groundwater sources, making use of alternative groundwater supplies difficult. Thus, severe drought may result in greater impacts to the portions of the region entirely dependent on surface water than to the other portions of the region.
- The technical approach does not consider the increase in demand (both human and non-human) on the hydrologic system during a drought.
- The administrative supply does not consider the long-term decline in water supplies due to increased temperatures, reduced snow pack, and increased evapotranspiration.
- Water supply is impacted by water quality, and the estimate of future supplies from groundwater does not consider the quality of the water that may be naturally saline as depth increases or groundwater that is contaminated in large areas, such as in the vicinity of the copper mines in the Mimbres valley. Surface water is also vulnerable to contamination, such as the impacts to the Animas and San Juan rivers in the San Juan Basin planning region due to the 2015 Gold King Mine spill, or from ash and debris flows following catastrophic wildfires.
- The drought-corrected surface water and groundwater supplies identify an order of magnitude quantity of water that may be available in a severe drought without considering priority dates of water rights and how limited supplies

may be administered under drought conditions. For example, the Rio Grande Compact constrains reservoir storage in northern New Mexico during times of drought when water levels are low in Elephant Butte Reservoir. Administration on the Rio Chama provides native flow to senior users but protects storage releases for downstream users. Thus, a linear adjustment to the surface water supply does not reflect the complexity of how river basins are managed.

- Actual physical supply may be sufficient to meet surface water supplies, even in drought years, depending on the point of diversion (or withdrawal) within the stream. For instance, the minimum stream flow on the mainstem of the Rio Grande above the Otowi gage is more than enough to meet the surface water demands of direct diversions from Pilar to Otowi.
- Groundwater declines are also occurring in some stream-connected aquifers. The long-term ability of groundwater to sustain existing pumping rates has not been examined for stream-connected aquifers in this *2018 New Mexico State Water Plan*. Spring flow from groundwater that discharges to surface water may also be declining in areas with groundwater pumping, an impact that may not manifest in a river for many decades. Quantifying these impacts require numerical models that simulate surface and groundwater interaction and could be performed for future planning efforts.
- Compact obligations, priority administration, riparian evapotranspiration, and instream flow to meet Endangered Species Act needs are not explicitly represented in the administrative supply. While the 2010 water diversions were used to represent "average" supply, that supply was dependent on the amount of water in storage and the other factors that allowed the state to meet legal obligations. Thus, changes in the volume of water in storage to meet the 2010 water demands or changes in total riparian evaporation, for instance, will impact the supply, even in an average year.
- The water planning regions are large, and it is important to note that each entity within each region and water use category must plan for their water supply future. Water is not necessarily shared, so although one PWS, for instance, may be resilient during drought, another may be severely impacted, even though both are in the same planning region.

3.5.4 Estimated Average and Drought-Corrected Supplies by Region

The administrative and drought-corrected surface water and groundwater supplies for the 16 planning regions are shown in Figure 3-10 (2010 only) and Table 3-1 (2010-2060). As shown on Table 3-1, the drought supply is significantly lower than the administrative water supply in regions that are heavily surface water dependent, especially the Mora-San Miguel-Guadalupe, Colfax, San Juan and Rio Chama regions, where more than 90% of the supply is from surface water.



Note:
*Available water supply calculated instead of administrative water supply due to unique conditions in the San Juan Basin planning region; including

1) substantial reservoir capacity that was developed to allow the water in the San Juan River to be used,
2) authorized full development of federal water supply projects,
3) actual diversion practices and reservoir operations on the San Juan and Animas rivers, and
4) the water apportionments made to New Mexico by the Colorado River and Upper Colorado River Basin Compacts, as detailed in Appendix 2A.

Figure 3-10. Administrative and Drought-Corrected Water Supply in 2010 as Reported in the Regional Water Plans.

Table 3-1. Administrative and Drought-Corrected Water Supply 2010-2060 as Reported in the Regional Water Plans.

Region		Supply	Amount (ac-ft)					
			2010	2020	2030	2040	2050	2060
1	Northeast New Mexico	Administrative	528,450	427,580	326,710	225,830	180,940	139,330
		Drought	463,330	351,660	240,000	138,090	90,030	63,950
2	San Juan Basin*	Administrative	876,300	876,300	876,300	876,300	876,300	876,300
		Drought	729,630	729,630	729,630	729,630	729,630	729,630
3	Jemez y Sangre	Administrative	90,480	90,480	90,480	90,480	90,480	90,480
		Drought	48,390	48,390	48,390	48,390	48,390	48,390
4	Southwest New Mexico	Administrative	222,540	212,190	201,840	191,490	181,140	175,020
		Drought	143,610	131,590	119,560	107,540	96,750	90,190
5	Tularosa-Sacramento-Salt Basins	Administrative	32,810	31,500	30,180	28,870	27,550	26,240
		Drought	28,310	26,310	24,310	22,300	20,300	18,300
6	Northwest New Mexico**	Administrative	26,140	26,140	35,990	34,340	32,690	31,040
		Drought	21,840	21,840	31,140	28,940	26,740	24,540
7	Taos	Administrative	120,510	120,510	120,510	120,510	120,510	120,510
		Drought	37,340	37,340	37,340	37,340	37,340	37,340
8	Mora-San Miguel-Guadalupe	Administrative	109,210	109,210	109,210	109,210	109,210	109,210
		Drought	10,680	10,680	10,680	10,680	10,680	10,680
9	Colfax	Administrative	60,570	60,570	60,570	60,570	60,570	60,570
		Drought	8,360	8,360	8,360	8,360	8,360	8,360
10	Lower Pecos Valley	Administrative	597,280	597,280	597,280	597,280	597,280	597,280
		Drought	443,300	443,300	443,300	443,300	443,300	443,300
11	Lower Rio Grande	Administrative	450,000	448,630	447,270	445,910	444,540	443,180
		Drought	240,770	238,860	236,950	235,050	233,140	231,230
12	Middle Rio Grande	Administrative	431,640	431,640	431,640	431,640	431,640	431,640
		Drought	228,960	228,960	228,960	228,960	228,960	228,960
13	Estancia Basin	Administrative	84,130	80,290	76,450	72,610	68,770	64,930
		Drought	84,070	76,840	69,610	62,380	55,150	47,920
14	Rio Chama	Administrative	98,090	98,090	98,090	98,090	98,090	98,090
		Drought	17,030	17,030	17,030	17,030	17,030	17,030
15	Socorro-Sierra	Administrative	303,720	303,720	303,720	303,720	303,720	303,720
		Drought	140,170	140,170	140,170	140,170	140,170	140,170
16	Lea County	Administrative	197,100	186,800	176,510	166,210	155,920	145,620
		Drought	197,020	183,810	170,590	157,380	144,160	130,950

*Available water supply was calculated instead of administrative water supply in the San Juan Basin RWP as described in Appendix 2A.

** Groundwater supplies are expected to decline in the Northwest New Mexico planning region, but the available water supply is expected to increase beginning in 2024 due to the Navajo-Gallup Water Supply Pipeline coming online. See Northwest New Mexico RWP for details.

4. Water Demand

To effectively plan for meeting future water resource needs, it is important to understand different factors which affect water demand. Water planners evaluate current trends in water use as well as any anticipated future changes. While changes in population have an impact on demand, other factors such as changes in per capita demand or in a particular water use category, such as an increase in industrial uses in a region, also influence the demand for water.

Water use data is compiled in *New Mexico Water Use by Categories 2010* (Longworth et al., 2013). The categories are established as follows:

- Public Water Supply
- Irrigated Agriculture
- Reservoir Evaporation
- Commercial (self-supplied)
- Mining (self-supplied)
- Domestic (self-supplied)
- Livestock (self-supplied)
- Industrial (self-supplied)
- Power (self-supplied)

Each RWP included a summary of current water use by category; an evaluation of population and economic trends and projections of future population; a discussion of the approach used to incorporate water conservation in projecting future demand; and projections of future demand for water withdrawals under “low” demand and “high” demand scenarios.

The RWPs represent the most current evaluation of population, economic changes, and water use forecasts, and are therefore summarized to reflect statewide water use forecasts. Each regional water plan included a high and low projection of both population and overall water demand to bracket the potential changes through 2060.

4.1 PRESENT WATER USES

The most recent assessment of water use by categories as featured in the 2016-2017 RWP updates was compiled in OSE Technical Report 54, *New Mexico Water Use by Categories 2010* (Longworth et al., 2013). This report provides information on total withdrawals (diversions) for the categories of water use shown in Figure 4-1.

Irrigated agriculture diverted about 80% of the water diverted in 2010 in the state, with public water suppliers diverting 7.8%, and reservoir evaporation consuming 6.4%. It is important to note that the water use information compiled in the RWPs is an assessment of the diversions and not the depletions of water (except for reservoir evaporation). In many cases, some portion of diverted water returns to surface or groundwater; for example, agricultural runoff or seepage, or discharge from wastewater treatment plants, which can be 50% or more.

New Mexico Water Use by Categories 2010 (Longworth et al., 2013) includes estimates of irrigation efficiency (on-farm and off-farm diversion requirements), and the consumptive irrigation requirement (CIR) per acre of crop irrigated. Longworth et al. (2013) does not include estimates of incidental depletions, which is the amount of water that does not seep back into the underlying aquifer or return to a stream or ditch, but is consumed through direct evaporation from ponded water, canals and laterals, or evapotranspiration from vegetation along ditch banks.

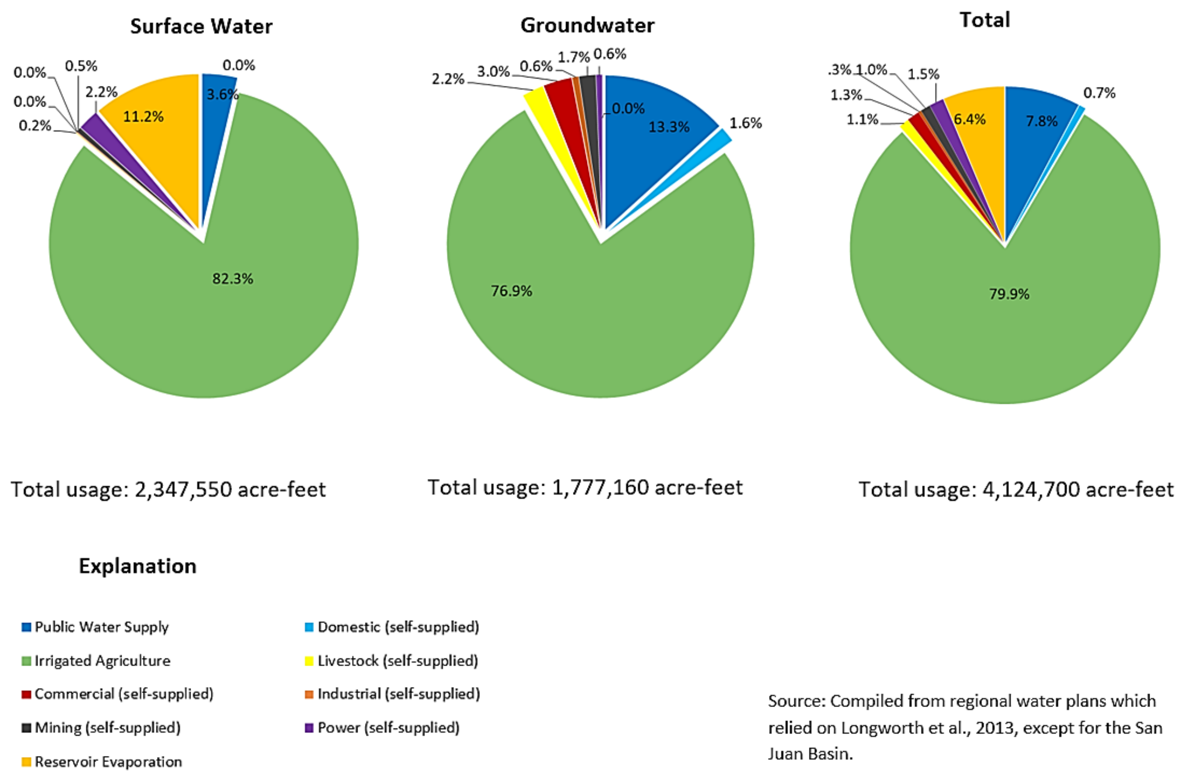


Figure 4-1. Statewide Water Withdrawals by Use Category in 2010.

In addition, there are other categories of unquantified and quantified water use, including riparian evapotranspiration, instream flow, and compact obligations, which are discussed below. The process used in estimation of water use for *New Mexico Water Use by Categories 2010* (Longworth et al., 2013) reasonably captures both tribal and non-tribal water use.

Riparian evapotranspiration: Some research and estimates have been made for riparian evapotranspiration in selected areas, such as along the middle and lower Rio Grande (Thibault and Dahm, 2011; Coonrod and McDonnell, Undated; Bawazir et al., 2009); however, riparian evapotranspiration has not been quantified statewide. Though riparian evapotranspiration is anticipated to consume a relatively large quantity of water statewide, it will not affect the calculation of the gap between supply and demand using the method in this report because supply and demand for evapotranspiration are removed from the equation. If the supply was based on flow in the streams and precipitation, then evapotranspiration would need to be included explicitly as a demand. The only impact to the gap calculation would be if evapotranspiration significantly changes in the future. There is potential for such a change due to warming temperatures; however, anticipated changes have not been quantified and would be subject to considerable uncertainty. Anticipated changes in riparian and stream evapotranspiration are both areas that should be considered in future regional and state water plan updates.

Instream flow: The analysis of the gap between supply and demand relies on the largest use categories that reflect withdrawals for human use, or on reservoir storage that allows for withdrawals downstream upon the release of the stored water. It is recognized that there is also value in preserving instream water for ecosystem, habitat, cultural and traditional purposes of the Pueblos, and tourism purposes. Although this value has not been quantified in the supply/demand gap calculation, it is an important use in many parts of the state, and instream/environmental flow protections and projects were identified in several of the 2016-2017 RWP updates.

Compact obligations: A legally binding set of rules regarding the amount of water that must be delivered to a downstream state or which place limitations on the amount of water that may be consumed within a region. Compact obligations are, in effect, another water use category that is not explicitly defined in the regional water plans. Instead, compact obligations were incorporated into the regional water planning process by not including the demand or the supply to meet interstate compact obligations. One argument for basing the administrative supply on the amount that was diverted in a “normal year” is that it represents the supply available after compact obligations are considered for the year 2010. If the supply was based on flow in the streams and capacity of wells, then the compact obligations would need to be included explicitly as a demand.

Figure 3-1 and Table 4-1 show the degree to which a region is dependent on surface water or groundwater in 2010. The San Juan Basin and Rio Chama planning regions, for example have minimal, shallow groundwater resources, but ample surface water in non-drought years. The planning regions along the Rio Grande rely on surface water, but also have groundwater resources to meet a significant portion of the water demands. The Lea County and the Estancia Basin planning regions rely entirely on groundwater from aquifers that are diminishing.

The surface water/groundwater distribution, as illustrated in Figure 3-1, is expected to shift in some planning regions by 2030 (when the Ute Reservoir Pipeline brings surface water supplies to some communities in eastern New Mexico and the Navajo-Gallup Water Supply Project delivers additional surface water to the Northwest New Mexico planning region).

The total use by category for the entire state of New Mexico is shown on Figure 4-1. Total surface water and groundwater withdrawals for each planning region are shown in Table 4-1. The San Juan Basin planning region included the category of “export water” to account for the trans-basin diversion of San Juan-Chama Project water out of the planning region. Diversion of San Juan-Chama water is already accounted for in other regions, thus it is not included as a water supply or demand for the San Juan Basin planning region in the State Water Plan.

Figure 4-2 and Figure 4-3 show the location of surface water and groundwater diversion points in New Mexico based on the OSE water rights database (OSE, 2018), which does not necessarily include tribal water rights. The database is not complete and continues to be updated by abstracting water rights basin by basin to improve the accuracy of locations and other information.

As shown in Figure 4-1 and Figure 4-4, irrigated agriculture is the largest water use category in New Mexico. The breakdown of categories, shown in Figure 4-4 and detailed in Section 5, indicates that most of the water is used for irrigated agriculture in all planning regions except the Northwest planning region, where slightly more water is withdrawn for the public water supply category. Even in the Middle Rio Grande planning region, where 132,000 acre-feet (ac-ft) were withdrawn for public water supply, the largest use category is irrigated agriculture. Figure 4-5 shows the detail of water demand for each region by use category without irrigated agriculture and reservoir evaporation.

Table 4-1. Total 2010 Withdrawals in New Mexico Water Planning Regions.

Region Number	Region	Withdrawal (ac-ft)		Total Withdrawal (ac-ft)
		Surface Water	Groundwater	
1	Northeast New Mexico	67,136	461,312	528,448
2	San Juan Basin	776,371	4029	770,400
3	Jemez y Sangre	70,143	20,334	90,477
4	Southwest New Mexico	87,693	134,842	222,535
5	Tularosa-Sacramento-Salt Basins	10,005	22,810	32,814
6	Northwest New Mexico	3,757	24,037	27,793
7	Taos	96,710	23,802	120,511
8	Mora-San Miguel-Guadalupe	101,990	7,215	109,205
9	Colfax	55,549	5,024	60,573
10	Lower Pecos Valley	181,157	416,123	597,279
11	Lower Rio Grande	271,717	178,279	449,996
12	Middle Rio Grande	302,514	129,126	431,640
13	Estancia Basin	60	84,069	84,129
14	Rio Chama	95,362	2,726	98,088
15	Socorro-Sierra	240,515	63,205	303,719
16	Lea County	75	197,024	197,099

Notes:
ac-ft = acre-feet
Source Longworth et al. (2013), except San Juan Basin withdrawals, provided by ISC Colorado River Bureau, 2016; The 105,800 ac-ft of San Juan-Chama exports included in the RWP for the San Juan Basin planning region were removed from the Surface Water column for the San Juan Basin planning region since that water is not actually physical diverted from the San Juan Basin within New Mexico and its inclusion leads to double accounting of surface water withdrawals on a statewide basis.

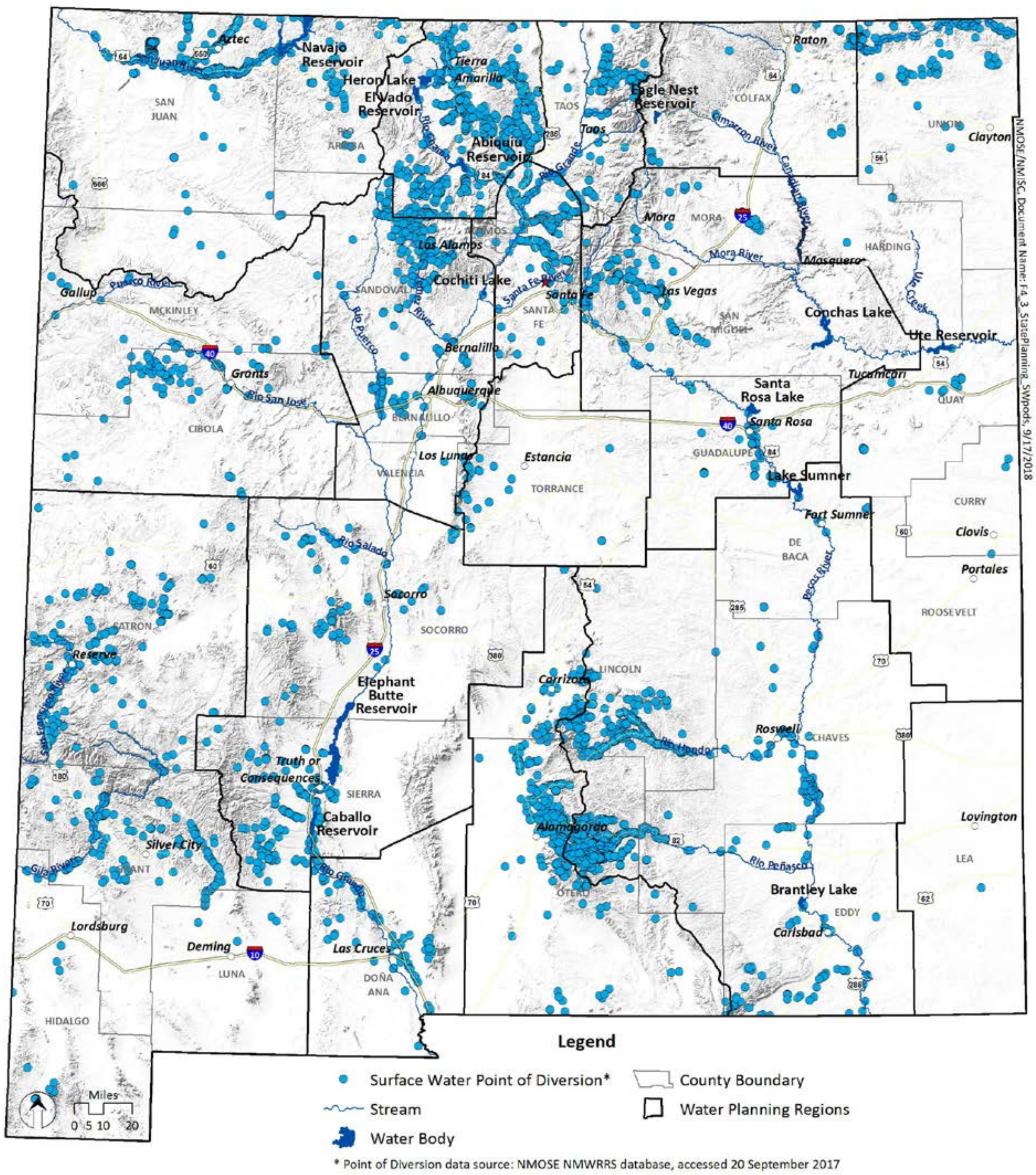


Figure 4-2. Surface Water Points of Diversion in New Mexico.

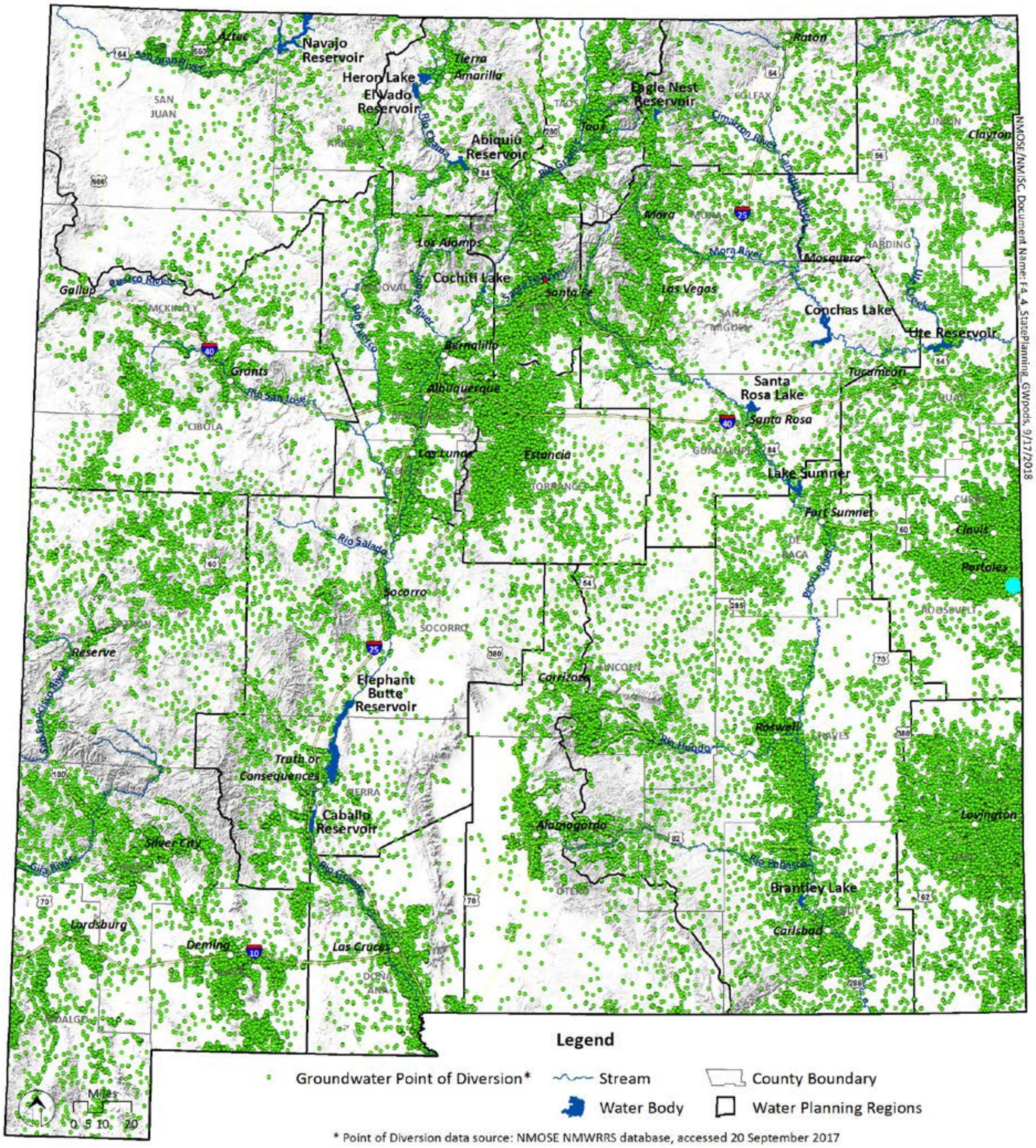


Figure 4-3. Groundwater Points of Diversion in New Mexico.

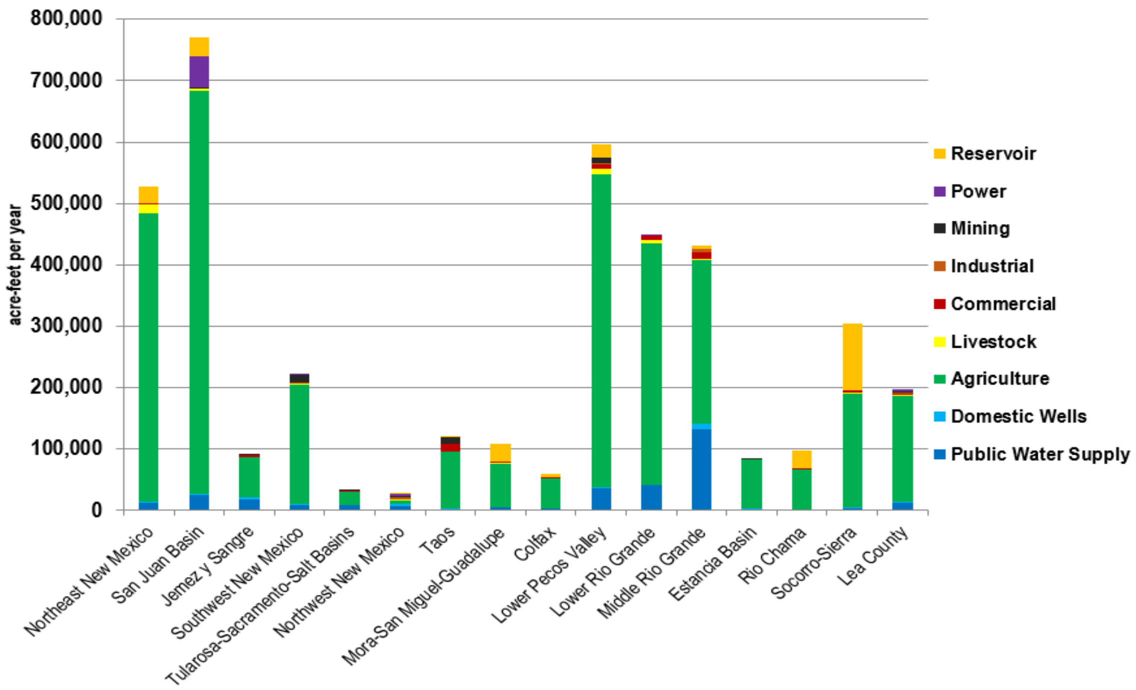


Figure 4-4. Water Demand by Category and Region for 2010 for All Categories.

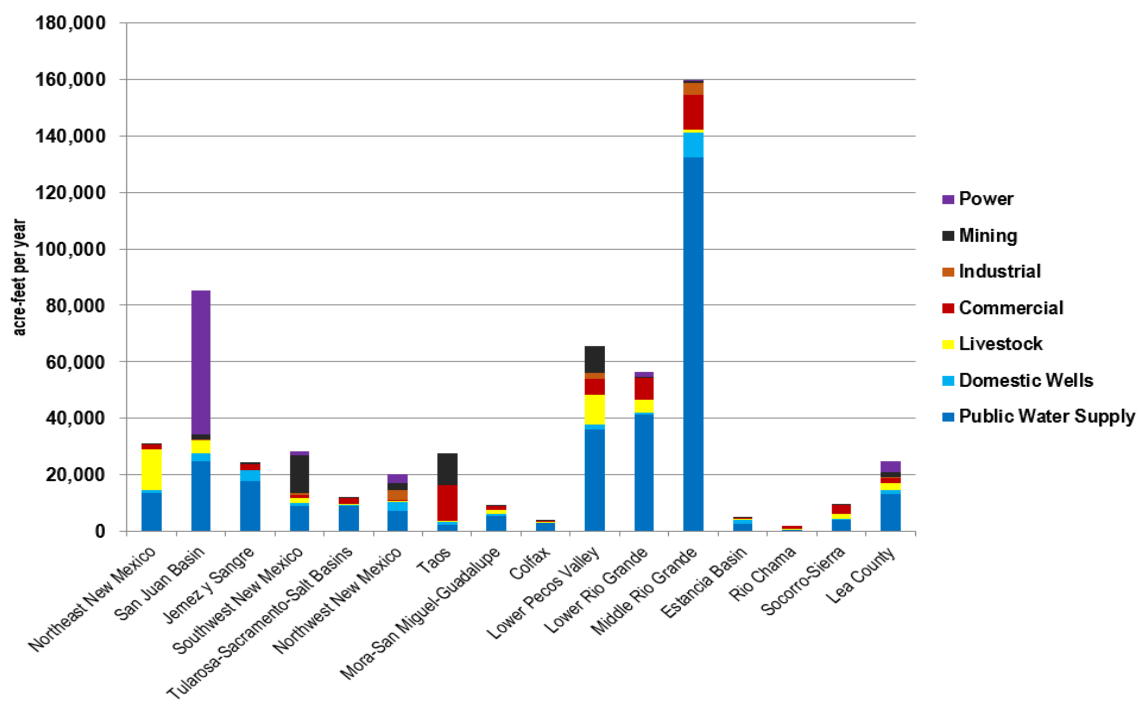


Figure 4-5. Water Demand by Category and Region in 2010, without Irrigated Agriculture and Reservoir Evaporation.

4.2 PROJECTING DEMOGRAPHIC AND ECONOMIC TRENDS

To project future water demands, it is important to first understand demographics, including population, economic, and land use trends. The 2013 populations of New Mexico (Census, 2014) were included in each RWP. In addition, the difference in population between the 2000 and 2010 census and 2013 estimates was evaluated for each planning region and each county to help understand trends in population growth.

Relevant information was evaluated for the economic sectors of each region. The Arrowhead Center at New Mexico State University provided information on the basic industries (i.e. mining, oil and gas, tourism) that support the economy of New Mexico counties (Arrowhead Center, 2013). Basic industries bring outside dollars into the economy. Other information included summaries of the largest employment categories in each region; agricultural information such as crop type, farm income, and the average age of farmers; and comprehensive plans for communities within that region. To supplement the published information, a series of interviews were conducted with local business and government leaders who were familiar with the local economic conditions and drivers for economic growth in each region. The details about this research are provided in the appendices of the RWPs.

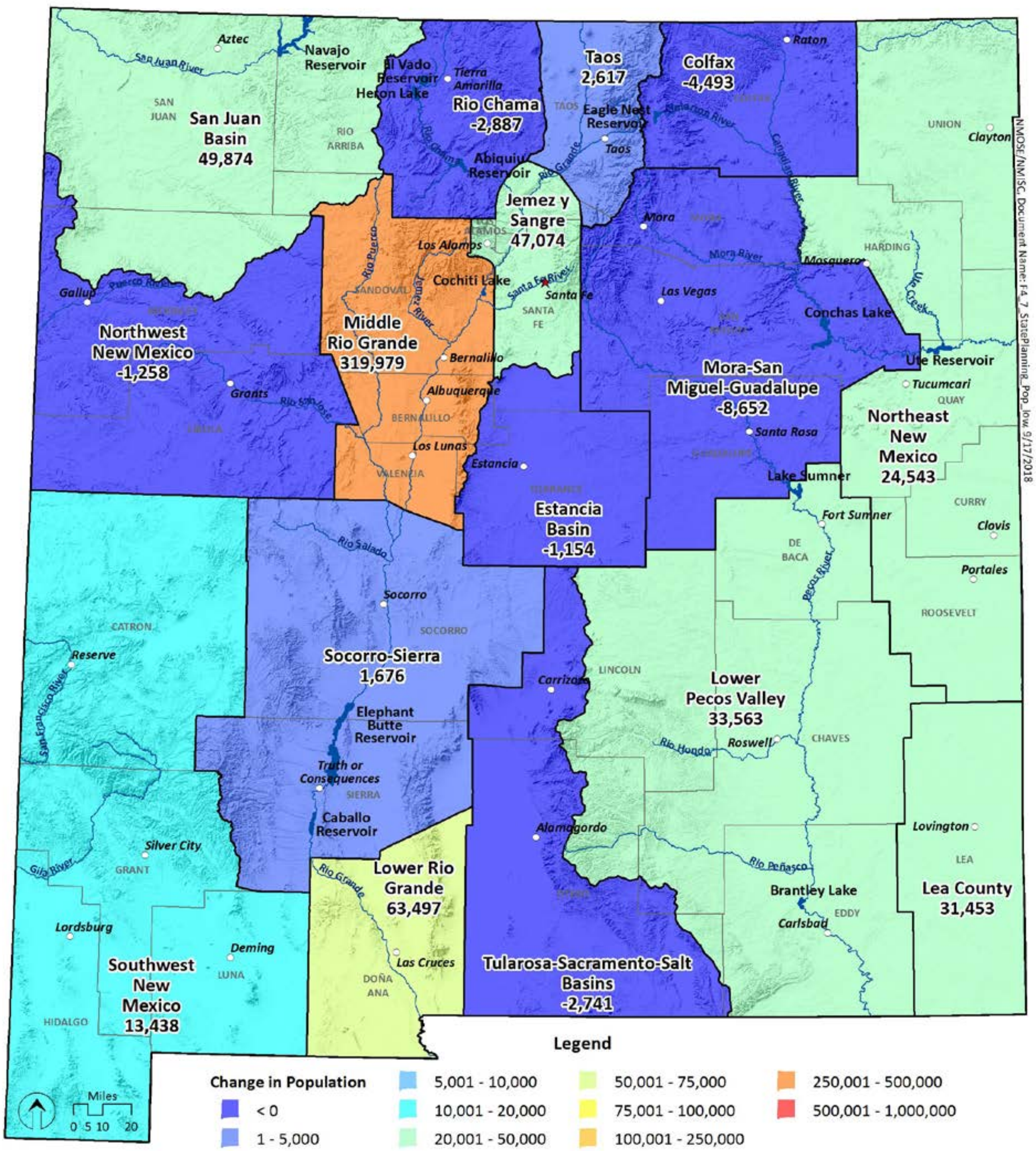
Based on the population trends and other information, a summary was developed as shown in Table 4-2 of the high and low population forecasts for each planning region.

The statewide population of New Mexico is expected to grow between approximately 500,000 (low projection, Figure 4-6) and 1,400,000 (high projection, Figure 4-7) by 2060, with the greatest growth expected in the Middle Rio Grande, San Juan Basin, Jemez y Sangre, and Lower Rio Grande planning regions. Population growth is not expected to be significant in some rural regions, as shown on Figure 4-6 and Figure 4-7. Current trends in declining populations are expected to continue in some of the regions under the low projection.

Table 4-2. New Mexico Water Planning Regions 2010 Population and Projected Population 2020-2060.

Region		Projection	Population					
			2010	2020	2030	2040	2050	2060
1	Northeast New Mexico	High	82,510	92,590	104,530	114,350	121,270	126,140
		Low	82,510	87,300	91,920	97,520	102,570	107,050
2	San Juan Basin	High	145,950	173,460	204,380	240,750	284,390	338,210
		Low	145,950	145,950	160,110	173,230	185,030	195,830
3	Jemez y Sangre	High	181,660	198,710	231,420	265,290	299,120	331,690
		Low	181,660	187,830	199,880	210,380	220,090	228,740
4	Southwest New Mexico	High	63,230	69,230	77,850	87,060	97,390	108,960
		Low	63,230	66,210	69,450	73,110	74,820	76,670
5	Tularosa-Sacramento-Salt Basins	High	61,980	64,650	65,700	66,180	65,940	64,950
		Low	61,980	62,510	62,620	61,440	60,460	59,240
6	Northwest New Mexico	High	87,720	95,920	104,350	113,470	123,340	134,030
		Low	87,720	90,780	91,770	90,560	88,780	86,460
7	Taos	High	39,730	43,810	46,620	48,700	50,980	53,520
		Low	39,730	41,360	43,080	43,310	42,800	42,350
8	Mora-San Miguel-Guadalupe	High	38,960	38,720	39,190	39,810	40,670	41,850
		Low	38,960	36,410	34,360	32,650	31,280	30,310
9	Colfax	High	13,750	13,090	13,090	13,090	13,090	13,090
		Low	13,750	12,380	11,510	10,700	9,950	9,260
10	Lower Pecos Valley	High	143,770	152,850	167,720	184,090	196,430	207,170
		Low	143,770	148,320	156,210	163,340	169,850	177,330
11	Lower Rio Grande	High	209,230	229,250	260,500	290,100	321,630	348,730
		Low	209,230	221,150	233,850	247,350	260,850	272,730
12	Middle Rio Grande	High	863,370	992,460	1,145,700	1,274,360	1,402,300	1,523,560
		Low	863,370	933,590	1,002,980	1,068,720	1,129,330	1,183,340
13	Estancia Basin	High	32,690	35,410	37,220	38,750	39,670	40,300
		Low	32,690	32,450	32,640	32,140	31,870	31,540
14	Rio Chama	High	6,790	6,680	6,510	6,190	5,910	5,750
		Low	6,790	6,080	5,440	4,870	4,360	3,910
15	Socorro-Sierra	High	29,850	29,820	31,490	33,500	35,030	35,500
		Low	29,850	28,790	29,920	30,740	31,220	31,530
16	Lea County	High	64,730	77,960	92,440	106,780	119,660	131,880
		Low	64,730	73,540	84,180	89,020	92,810	96,180
Total		High	2,065,920	2,065,920	2,314,590	2,628,700	2,922,450	3,216,810
		Low	2,065,920	2,065,920	2,174,650	2,309,890	2,429,090	2,536,040

Source: ISC (2016-2017)



Office of the State Engineer / Interstate Stream Commission	Figure 4-6. Projected Change in Population in New Mexico Water Planning Regions 2010-2060, Low Projection.

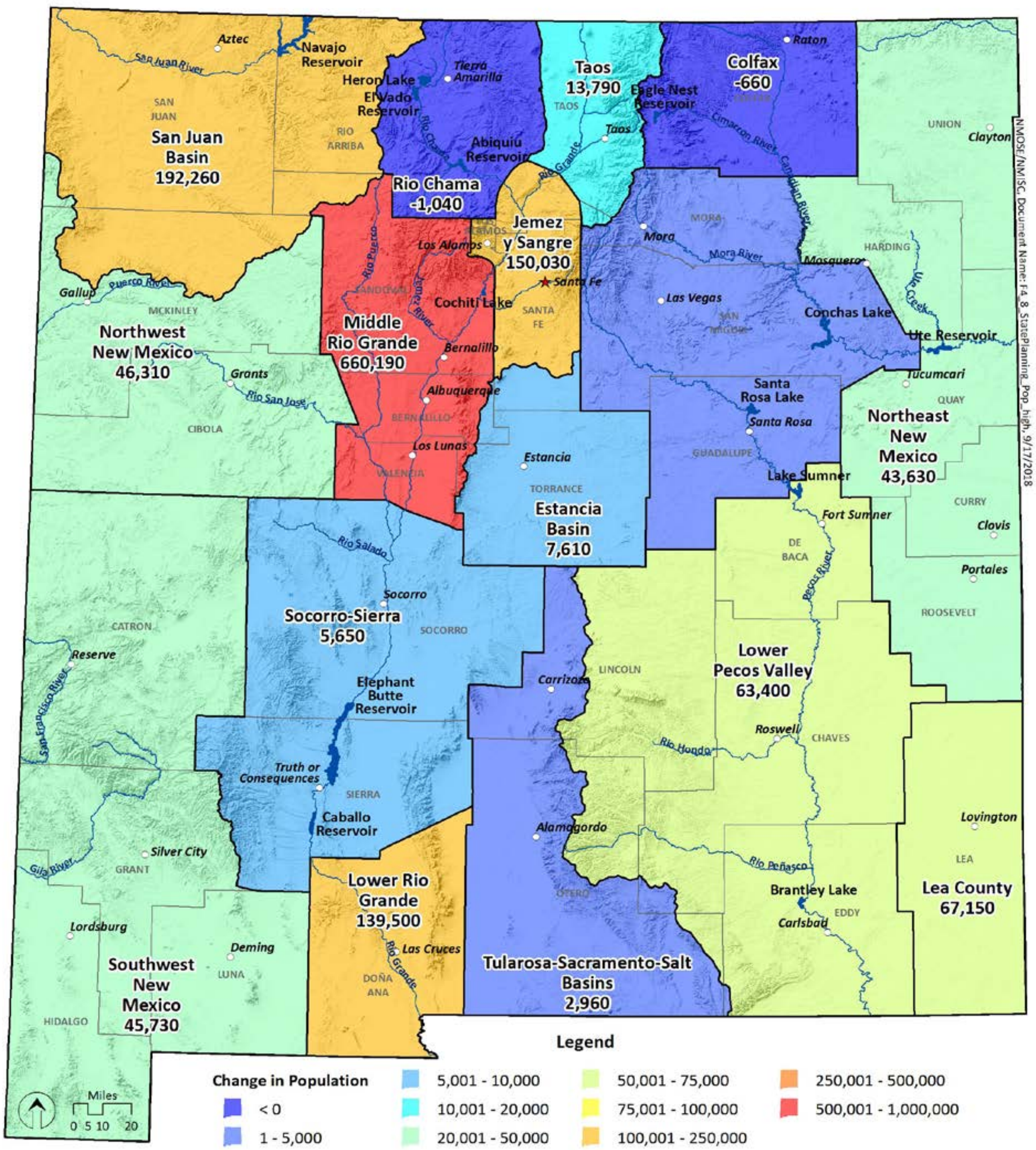


Figure 4-7. Projected Change in Population in New Mexico Water Planning Regions 2010-2060, High Projection.

4.3 DEVELOPING WATER DEMAND FORECASTS

Projections of future demand in nine categories of water use are based on demographic and economic trends and population projections prepared for the 2016-2017 RWP updates. Consistent methods and assumptions for each category of water use were applied across all planning regions. The projections began with 2010 data and were developed in 10-year increments (2020, 2030, 2040, 2050, and 2060). Projections were developed for withdrawals for each of the nine categories included in *New Mexico Water Use by Categories 2010* (Longworth et al., 2013).

To assist in bracketing the uncertainty of the projections, both low and high-water demand estimates were developed for each category in which growth is anticipated, based on demographic and economic trends as well as population projections, unless specific adjustments were applied based on local conditions. The projected growth in population and economic trends affects water demand in eight of the nine water use categories; the reservoir evaporation water use category is not driven by these factors.

The assumptions and methods used statewide to develop the demand projections for each water use category are detailed in Appendix 2A. Not all categories are applicable to every planning region. The specific methods applied in the various planning regions are detailed in each of the 2016-2017 RWP updates. Population projections were converted to water demand projections for the public water use and domestic self-supplied categories by assuming that the same per-capita demand would continue for the existing population and that new population would be served at a lower rate of water use depending on the region's per-capita demand. The San Juan Basin and Northwest New Mexico regions deviated from this approach based primarily on uncompleted and yet-to-be fully utilized federal water supply projects (the Navajo Indian Irrigation Project, or NIIP, the Animas-La Plata Project and the Navajo-Gallup Water Supply Project). These regions assumed that the increase in water availability would increase the water use because the availability of water will allow for economic growth, further increasing water use.

The projected water demand in each planning region is shown in Figure 4-8 and Table 4-3. The high demand projections for reservoir evaporation consider warmer temperatures as discussed in Appendix 2A. It is anticipated that increasing temperatures will contribute to increased agricultural demand and increased losses (riparian evapotranspiration and open water losses along river corridors); however, statewide quantitative estimates were not available at the time the projections were developed.

The increase in water demand for all use categories ranges from 400 to 250,000 acre-feet per year (ac-ft/yr) throughout the regions (as shown in Figure 4-8, depicting projected increase in demand from 2010 to 2060, under the high projection) and totals nearly 440,000 ac-ft of increased demands (including 15,100 ac-ft of increase in San Juan-Chama Project exports from the San Juan Basin). In the high-growth scenario, the region with the largest projected increase (250,000 ac-ft/yr) in future demand is the San Juan Basin planning region. The second-largest projected increase in demand is the Middle Rio Grande planning region, where an additional 79,000 ac-ft/yr would be required to meet population growth.

By water use sector, the increase in demand is projected to be 236,000 ac-ft/yr by 2060 in the public water supply and self-supplied domestic, commercial, and industrial water use categories, as shown in Figure 4-9. The forecast change in water demand for the agricultural and livestock use categories are shown in Figure 4-10, where most regions show little change, or a slight decrease and the San Juan Basin shows an increase of 159,000 ac-ft upon complete build out of NIIP which will provide additional water for agriculture. The projected increases in demand in the power and mining sector are shown in Figure 4-11, where most regions show little change, except for the San Juan Basin, Northwest New Mexico, and the Southwest New Mexico planning regions that predict increases in water demand.

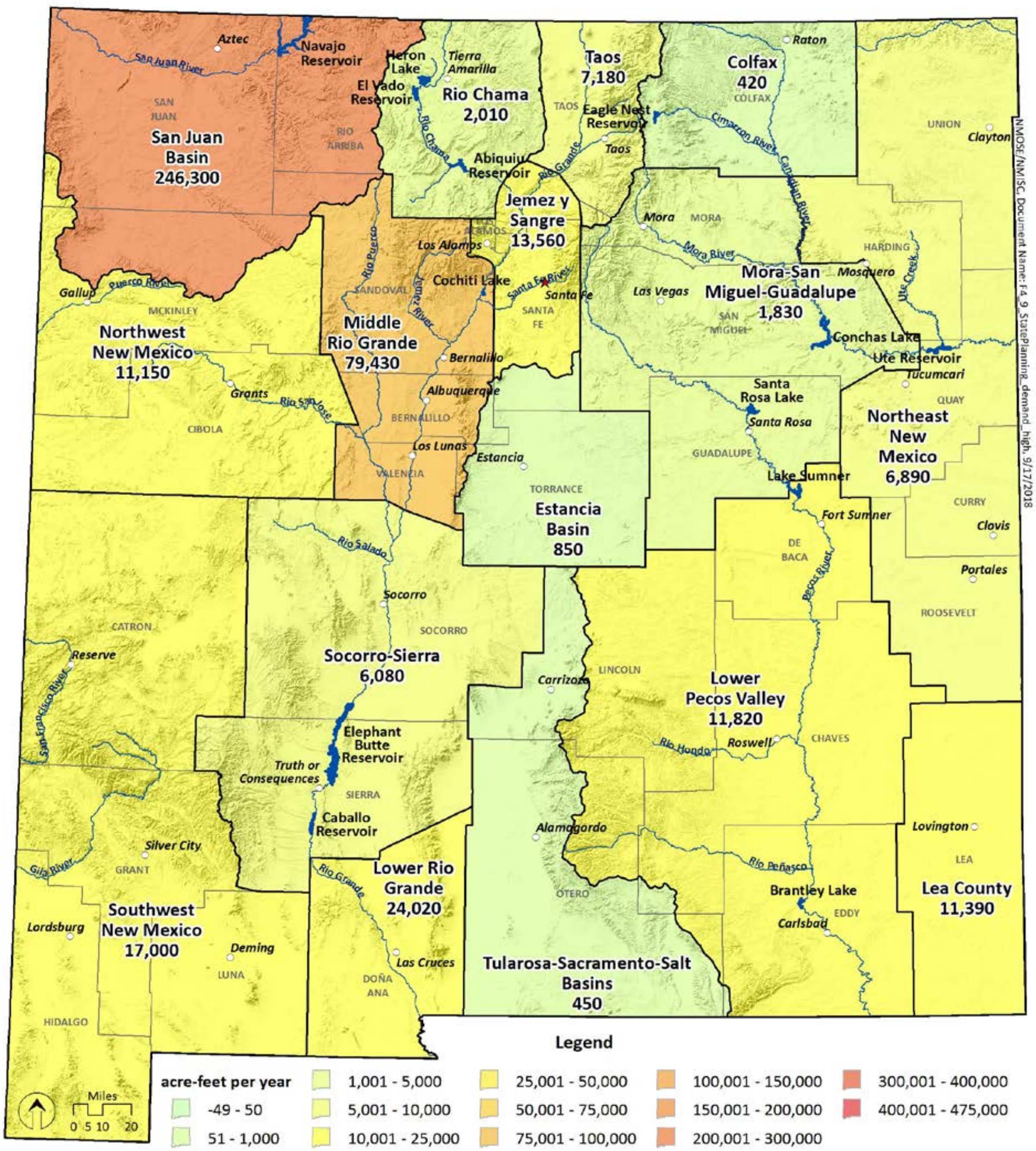


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Figure 4-8. Projected Increase in Demand from 2010 to 2060, High Projection.

Table 4-3. Reported Estimated (2010) and Projected Water Demand by Decade from 2020 to 2060 under the High and Low Projections.

Region		Projection	Projected Water Demand (ac-ft/ year)					
			2010	2020	2030	2040	2050	2060
1	Northeast New Mexico	High	528,450	524,590	528,190	530,850	532,650	535,340
		Low	528,450	409,770	432,940	442,990	465,810	480,870
2	San Juan Basin*	High	770,400	852,900	916,000	977,400	988,600	1,001,600
		Low	770,400	621,400	665,300	707,500	711,900	716,900
3	Jemez y Sangre	High	90,480	92,000	94,850	97,970	101,040	104,030
		Low	90,480	90,430	91,550	92,620	93,590	94,460
4	Southwest New Mexico	High	222,540	232,520	234,180	236,110	237,650	239,530
		Low	222,540	199,120	204,370	200,450	206,470	212,630
5	Tularosa-Sacramento-Salt Basins	High	32,810	33,010	33,140	33,210	33,250	33,260
		Low	32,810	29,540	30,390	30,410	31,230	31,250
6	Northwest New Mexico	High	27,790	31,230	32,990	34,790	36,770	38,940
		Low	27,790	28,160	28,710	29,010	29,490	29,800
7	Taos	High	120,510	111,560	123,960	125,130	126,370	127,690
		Low	120,510	110,640	122,730	123,130	123,140	123,140
8	Mora-San Miguel-Guadalupe	High	109,210	108,920	109,420	109,910	110,560	111,040
		Low	109,210	107,900	107,960	108,180	108,400	108,700
9	Colfax	High	60,570	60,200	60,630	60,740	60,820	60,990
		Low	60,570	60,060	60,100	60,140	60,160	60,180
10	Lower Pecos Valley	High	597,280	600,460	603,170	606,120	606,520	609,090
		Low	597,280	537,510	556,410	557,650	552,480	554,100
11	Lower Rio Grande	High	450,000	453,890	459,890	464,890	469,400	474,010
		Low	450,000	427,230	435,600	437,620	445,610	447,740
12	Middle Rio Grande	High	431,640	447,970	467,020	482,410	496,720	511,060
		Low	431,640	436,310	444,420	451,670	457,910	464,070
13	Estancia Basin	High	84,130	84,150	84,430	84,670	84,850	84,970
		Low	84,130	67,950	68,050	72,080	72,120	76,150
14	Rio Chama	High	98,090	98,350	98,740	99,130	99,410	100,100
		Low	98,090	97,960	97,990	98,010	98,040	98,050
15	Socorro-Sierra	High	303,720	309,460	305,230	306,670	308,120	309,790
		Low	303,720	284,070	287,020	291,330	293,190	294,620
16	Lea County	High	197,100	202,680	203,760	205,390	206,580	208,490
		Low	197,100	140,120	149,840	158,650	176,040	185,120
Total*		High	4,124,710	4,243,900	4,355,580	4,455,390	4,499,300	4,549,950
		Low	4,124,710	3,648,170	3,783,3602	3,861,440	3,925,580	3,977,780

**Does not include export water from the San Juan Basin to the Rio Grande Basin*

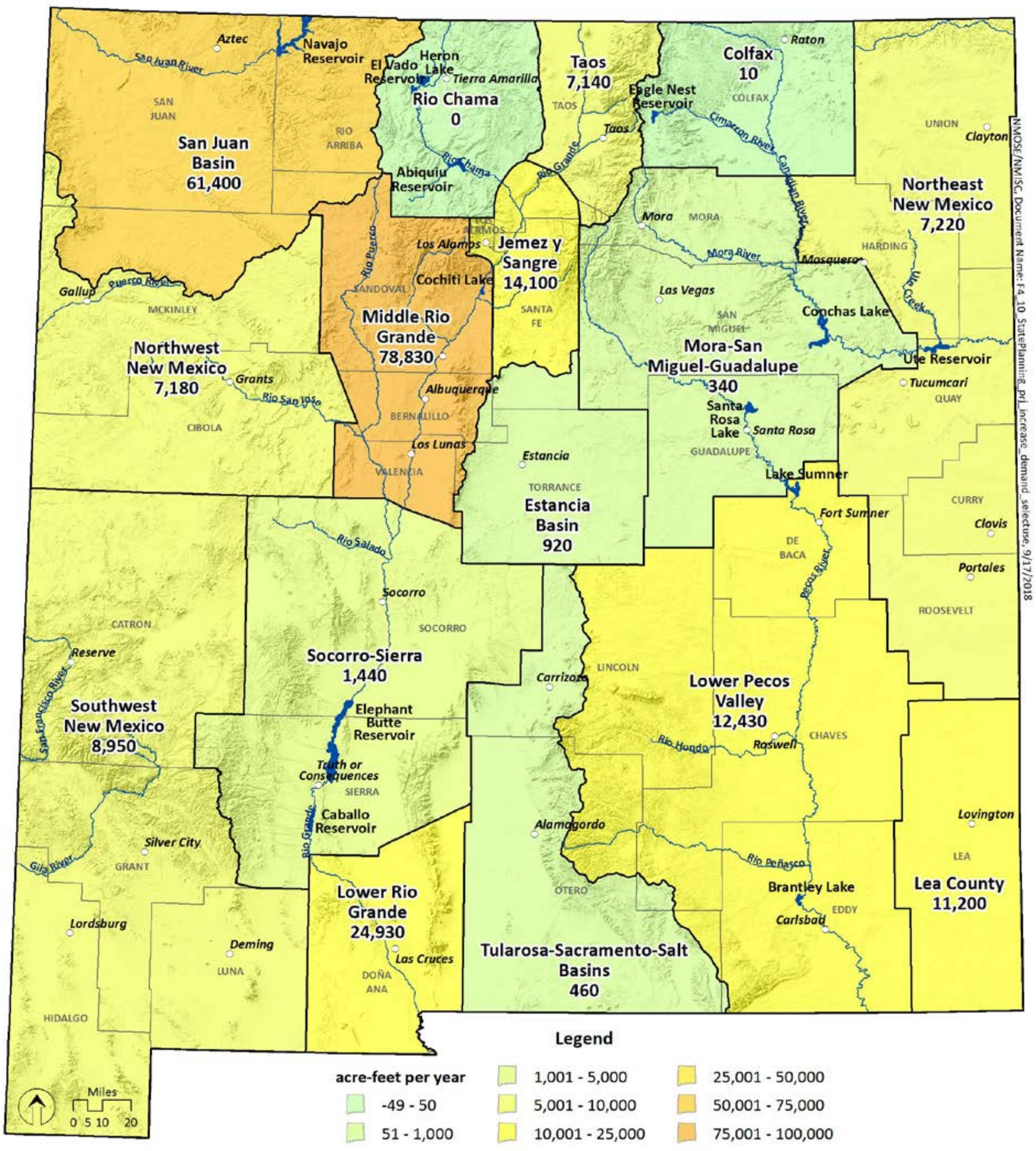

Figure 4-9. Projected Change in Water Demand from 2010-2060 for Public, Domestic, Commercial, and Industrial Self-Supplied Water Use Categories, High Growth Projection.

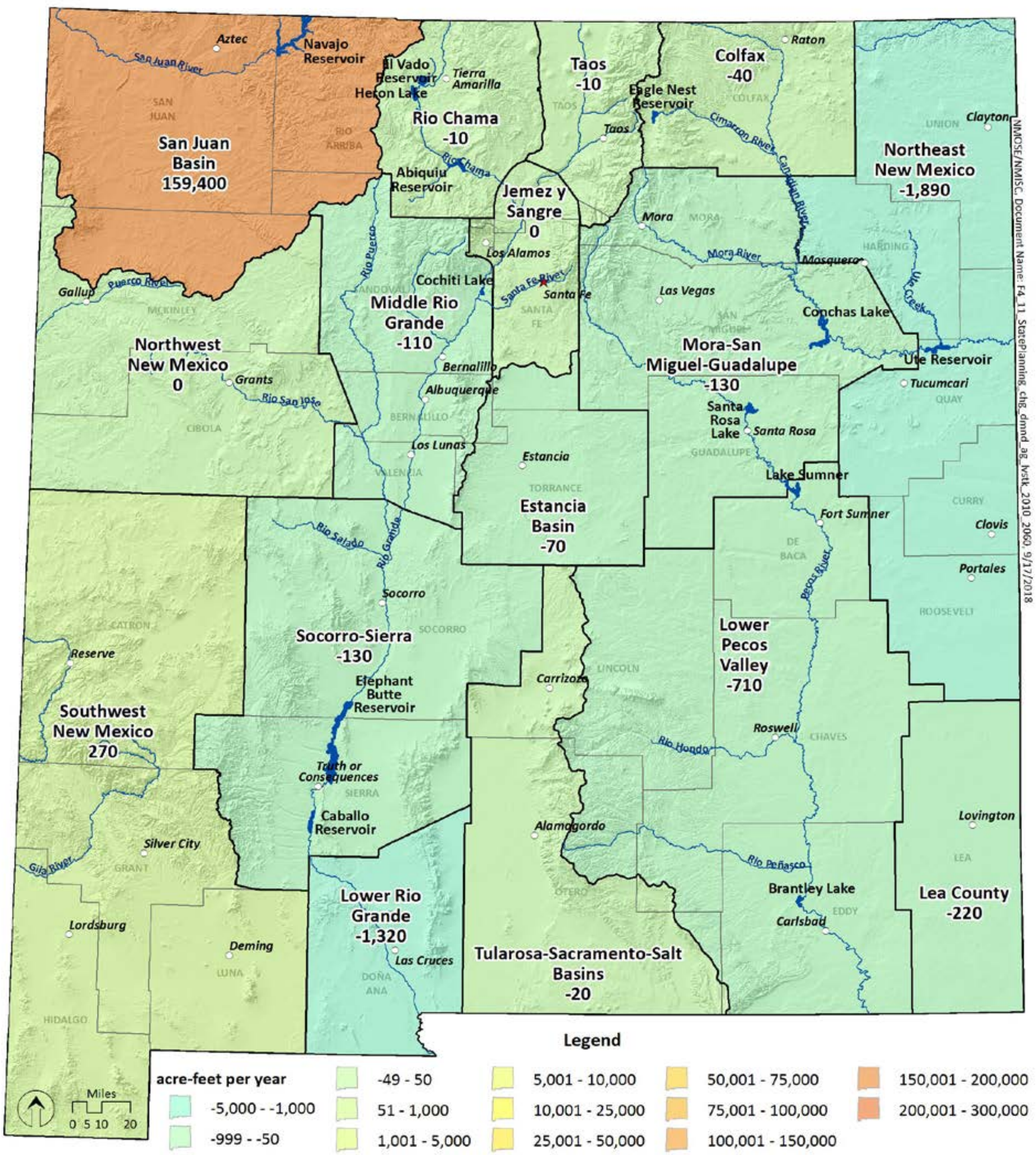

Figure 4-10. Change in Water Demand for the Agricultural and Livestock Water Use Categories 2010-2060.

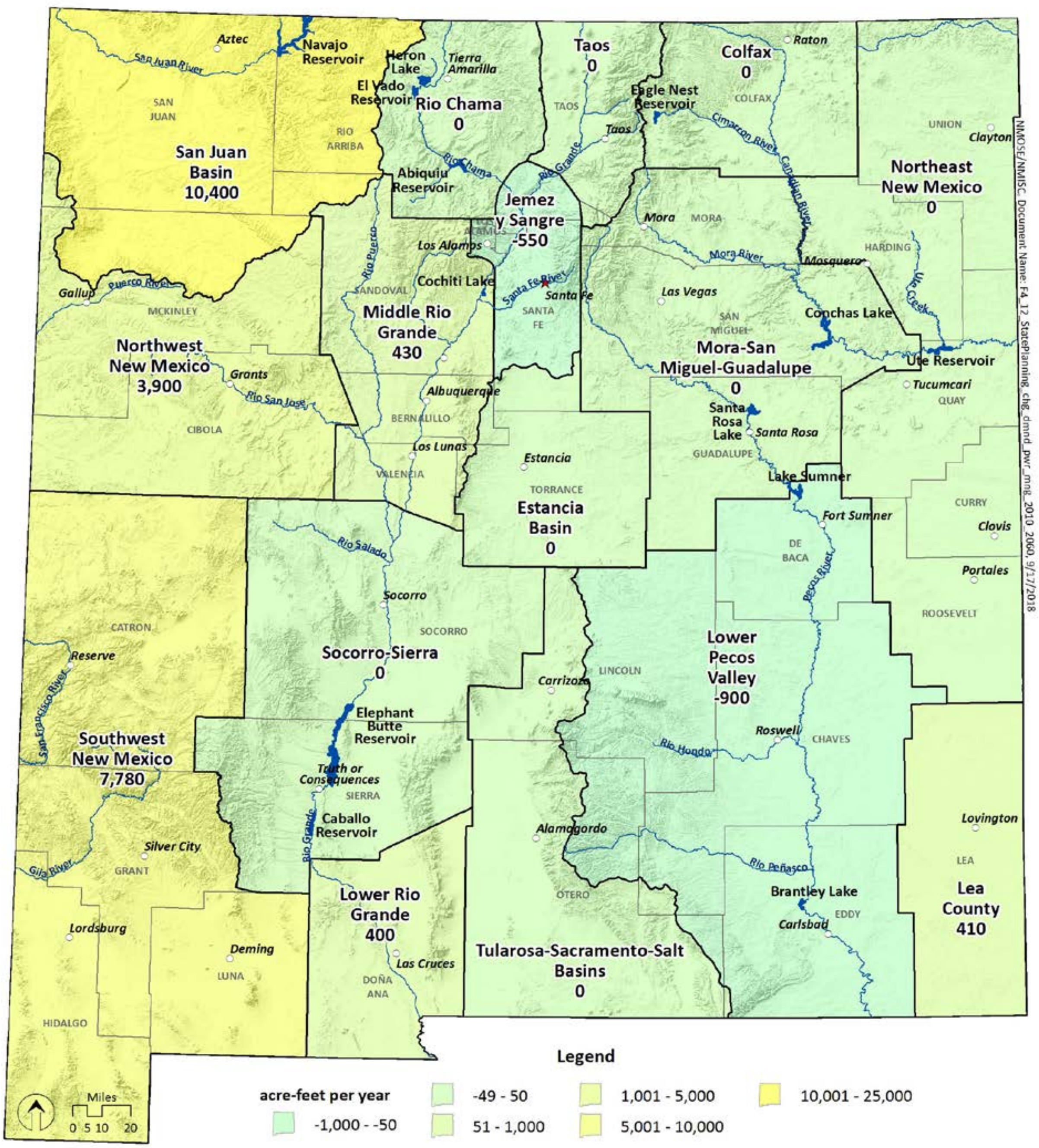

Figure 4-11. Change in Water Demand for the Power and Mining Water Use Categories 2010-2060.

5. Supply-Demand Gap

Paramount to water planning is projecting future water supply and demand in order to anticipate scenarios in which supply may not meet demand. The analysis of the supply-demand gap presented in this chapter is based on the administrative supply described in Section 3.5 and the demand in Section 4.3. Section 5.1 presents a summary of supply-demand gaps for total regional demand and Section 5.2 summarizes the projected supply and demand by region and by sector statewide. Section 5.3 presents supply and demand by region.

When looking at the balance between supply and demand, it is important to recognize that on a statewide or regional scale, the true gap cannot easily be described as a single number. Summing total demand and supply for a region or the state can be misleading, and it is important to understand that individuals, companies, cities, tribes, and farmers have independent rights to use water. Showing the totals for a region does not imply that the water held by one entity will be shared with another within the region, even if the infrastructure is available to share the water.

Other important considerations in the balance between supply and demand are listed below:

- The short-term variability in surface supplies results in a constantly fluctuating supply that triggers legal and policy constraints on water management.
- Supplies and demands are not independent variables that can be separately reconciled. Water use and development is much higher in areas where supplies are readily abundant. For instance, irrigated agriculture, with the largest use sector in the state, first evolved in areas where either surface water supplies were readily available and later expanded to areas where relatively shallow groundwater resources became economically available via high-capacity pumps and wells. If supplies are economically available, then agriculture or other uses are likely to be developed. This means that in an arid state, there will probably be higher interest in using water supplies wherever they can be economically attained. Thus, the demand is not actually independent of the supply.

Reviewing and evaluating gaps or potential gaps on a statewide or regional basis should consider that distinctly different water resources may be present at considerable distances from each other and moving an available water supply from one location to another can be expensive. Additionally, legal constraints (such as interstate compacts that constrain use, limit storage, or otherwise affect water management) may limit the ability of supplies in specific locations to meet demands in other areas.

- It is also important to consider the accuracy of the estimated diversion and demand numbers. If the estimates are as accurate as plus or minus 15%, that translates to plus or minus almost 700,000 ac-ft for statewide diversions.

Because of these complexities, caution is advised in evaluating the gaps in a region or the entire state; this analysis is intended to provide an understanding of general trends to help inform water policy.

5.1 OVERVIEW OF THE SUPPLY-DEMAND GAP

Figure 5-1 shows the projected demand (for withdrawals) under high and low demand projections and the supply available to meet those demands in an average supply scenario and in a drought-corrected supply scenario. The supply increases in 2020 due to the Navajo-Gallup Water Supply Project. Water demand exceeds the available supply under the high projection during normal water supply conditions by 2040. Under both the high and low projections, water demand is exceeded throughout the projection period during drought-corrected supply conditions.

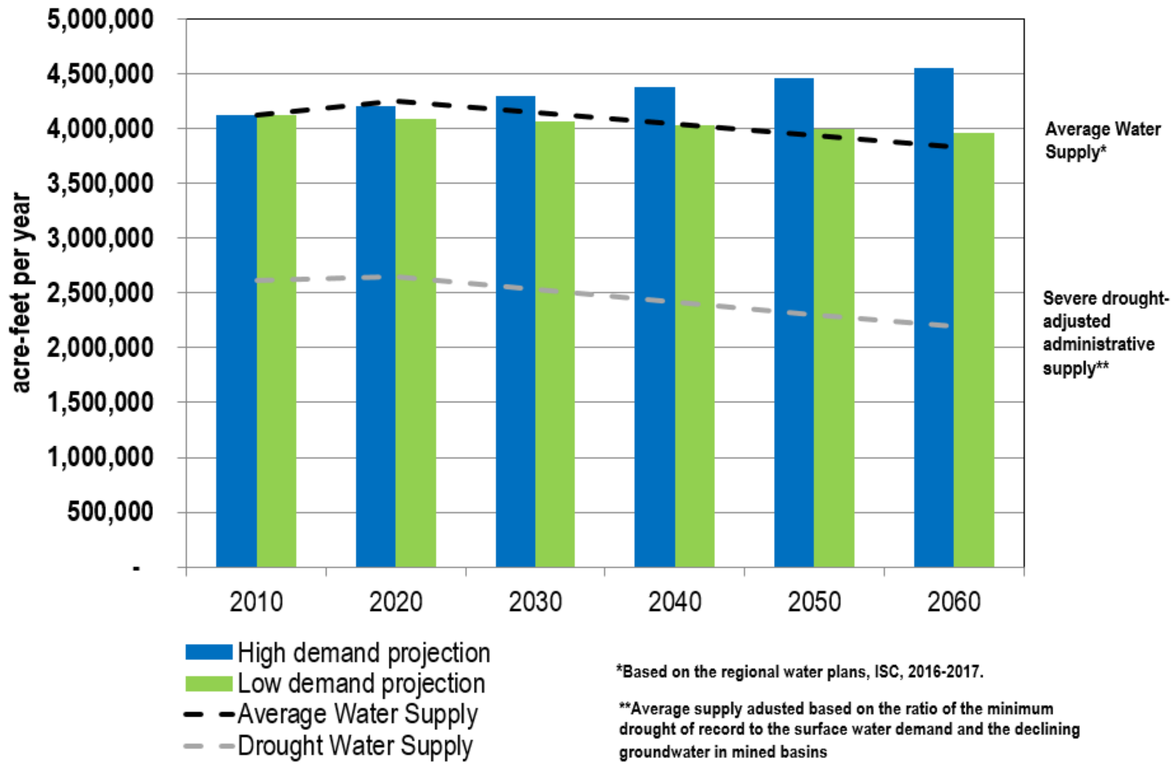

Figure 5-1. Statewide Supply and Demand under the High and Low Growth Projections.

The projected increase in demand of 440,000 ac-ft/yr by 2060 is one of the contributing factors creating a gap, but not the only one. Declining supplies in non-stream-connected aquifers and periods of drought can also create a gap between available supply and projected demand.

Under average supply projections, the groundwater supply in seven water planning regions is expected to decrease due to aquifer mining, widening the gap to about 700,000 ac-ft by 2060. Under the drought-corrected water supply scenario, the gap between supply and demand increases to 2.4 million ac-ft due to surface water shortages and accelerated groundwater mining. Figure 5-2 illustrates the projected gap under the high growth scenario for the average and drought-corrected supply scenarios. The gap is calculated by subtracting the demands in Table 4-3 from the supply in Table 3-1.

Declining supplies in stream-connected aquifers will also impact future supplies, but such impacts have not been incorporated in this analysis.

The Animas-La Plata, Navajo Indian Irrigation, and Navajo-Gallup Water Supply projects will provide an additional 250,000 ac-ft of water to the San Juan Basin and Northwest New Mexico planning regions for agriculture and public water use categories, an amount that was included in the water supply for those two regions.

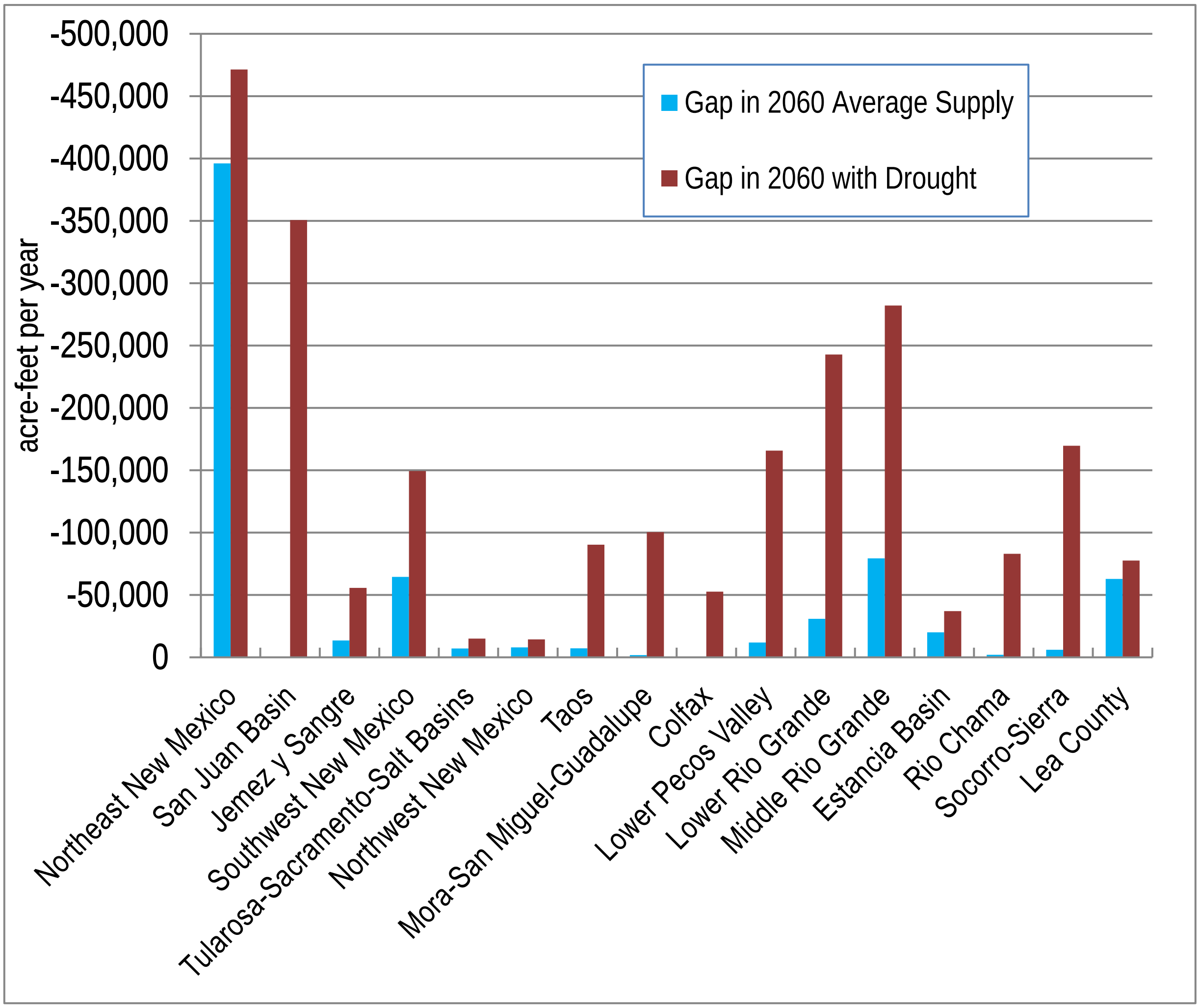

Figure 5-2. Projected Gap under the High Growth Scenario, with and without the Drought Correction in 2060.

In a normal or average water supply year a gap is projected for all the regions in 2060 except four (San Juan Basin, Lower Pecos Valley, Lower Rio Grande, and Middle Rio Grande). The most severely impacted regions in an average water supply year are the Northeast New Mexico, Southwest New Mexico, and Lea County. The overall statewide gap is, as expected, much greater in a drought-corrected water supply year than an average year. Figure 5-3 shows that all planning regions are impacted under the drought-corrected water supply scenario in 2060.

However, the San Juan Basin planning region is dramatically impacted during a drought-corrected water supply scenario because of the region's projected large increase in demand and its significant dependence on surface water. Even though the San Juan Basin planning region has ample reservoir storage, that source of supply is surface water; and if it is not available, then the gap could be almost 400,000 ac-ft. Under the low projection, no gap is predicted for the San Juan Basin planning region with the Navajo-Gallup Water Supply Project.

Though demand is not necessarily increasing significantly in some areas, the projected declines in supply in the closed basins (e.g. non-stream-connected basins) are forecasting gaps for those regions well before 2060. The OSE has considered the impact of pumping on the stream system when considering new appropriations in most stream-connected basins, which limits the amount of groundwater decline, while the closed basins have been allowed to be mined.

The projected 2060 declines in those planning regions with closed basins due to mining of the aquifer for an average year and for a drought-corrected water supply year are shown in Table 5-1.

The gap in the Northeast New Mexico and Lea County planning regions is of particular concern because alternative supplies have not been identified. The Ute Reservoir Pipeline Project is anticipated to provide up to 24,000 ac-ft to some PWSs, but will not supply water to agriculture, which will be the most impacted by the projected decline in the Ogallala/High Plains aquifer. In the Southwest New Mexico planning region, wells could potentially be deepened or developed in new locations; however, an evaluation of costs and feasibility has not been done.

Table 5-1. Annual Reduction in Groundwater Supply Estimated for Mined Basins.

Closed Basins in Region	Projected Reduction in Groundwater Supply in 2060 with No Drought (ac-ft)	Projected Reduction in Groundwater Supply in 2060 with a 20-year Drought (ac-ft)
1. Northeast New Mexico	389,000	400,000
4. Southwest New Mexico	48,000	53,000
5. Tularosa-Sacramento-Salt Basins	6,600	10,000
6. Northwest New Mexico	8,300	11,000
11. Lower Rio Grande	7,000	9,500
13. Estancia Basin	19,000	36,000
16. Lea County	50,000	65,000

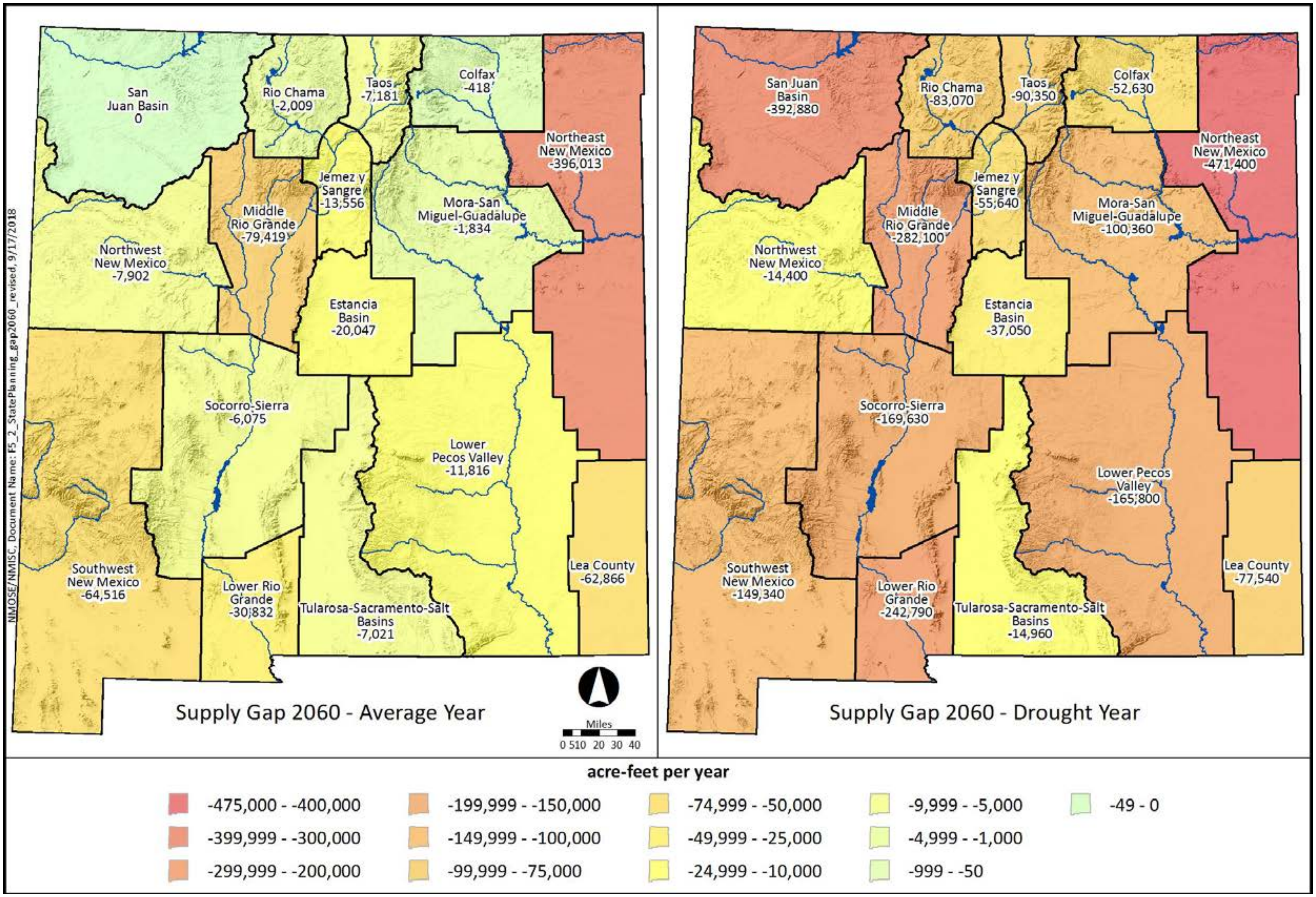

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Figure 5-3. Estimated Water Supply Deficit or Surplus for All Water Categories in 2060 for High Growth Projection for a) Average Water Supply and b) Drought.

While Figure 5-2 and Figure 5-3 show the total gap in terms of ac-ft/yr, the supply relative to the demand is revealed in Figure 5-4. During drought, the heavily surface-water-dependent regions (Mora-San Miguel-Guadalupe, Colfax, and Rio Chama) would have only 10, 14, and 17%, respectively, of the revised administrative water supply, creating extreme stress on their water supplies. The Northeast New Mexico planning region's drought-corrected supply is anticipated to be only 12% of the demand in 2060, due to the mining of the aquifer. While the amount of the gap is larger in other regions, addressing drought preparedness is vitally important in these three heavily surface water-dependent regions.

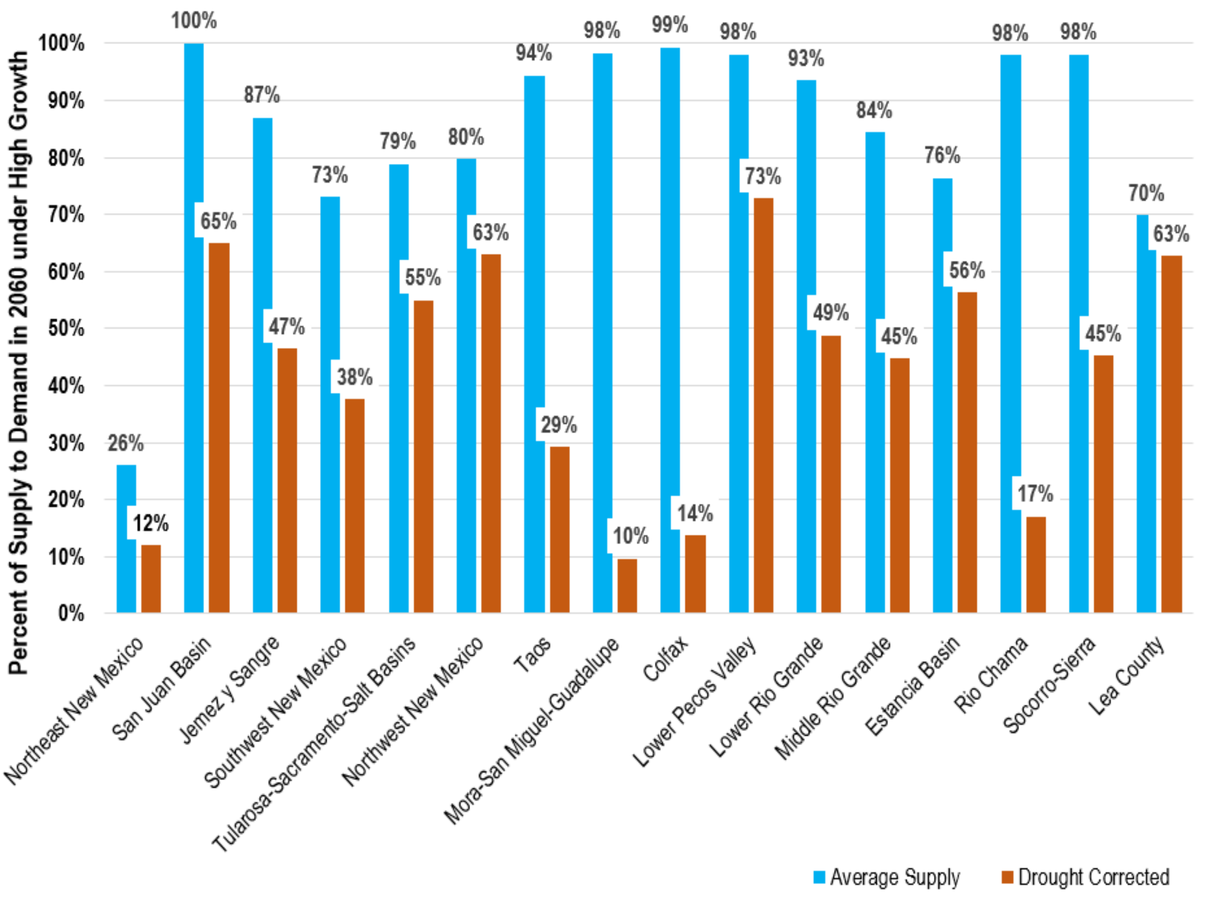

Figure 5-4. Percent of Supply Compared to Demand in 2060 by Region.

5.2 SUPPLY-DEMAND GAP BY WATER USE SECTOR STATEWIDE

The combined water supply and demand statewide by sector for the high and low projections is shown in Figure 5-5 and Figure 5-6. The gap in 2060 under the high growth scenario with all categories of water use is estimated to be 700,000 ac-ft in an average supply year and 2,400,000 ac-ft in the drought-corrected scenario, respectively.

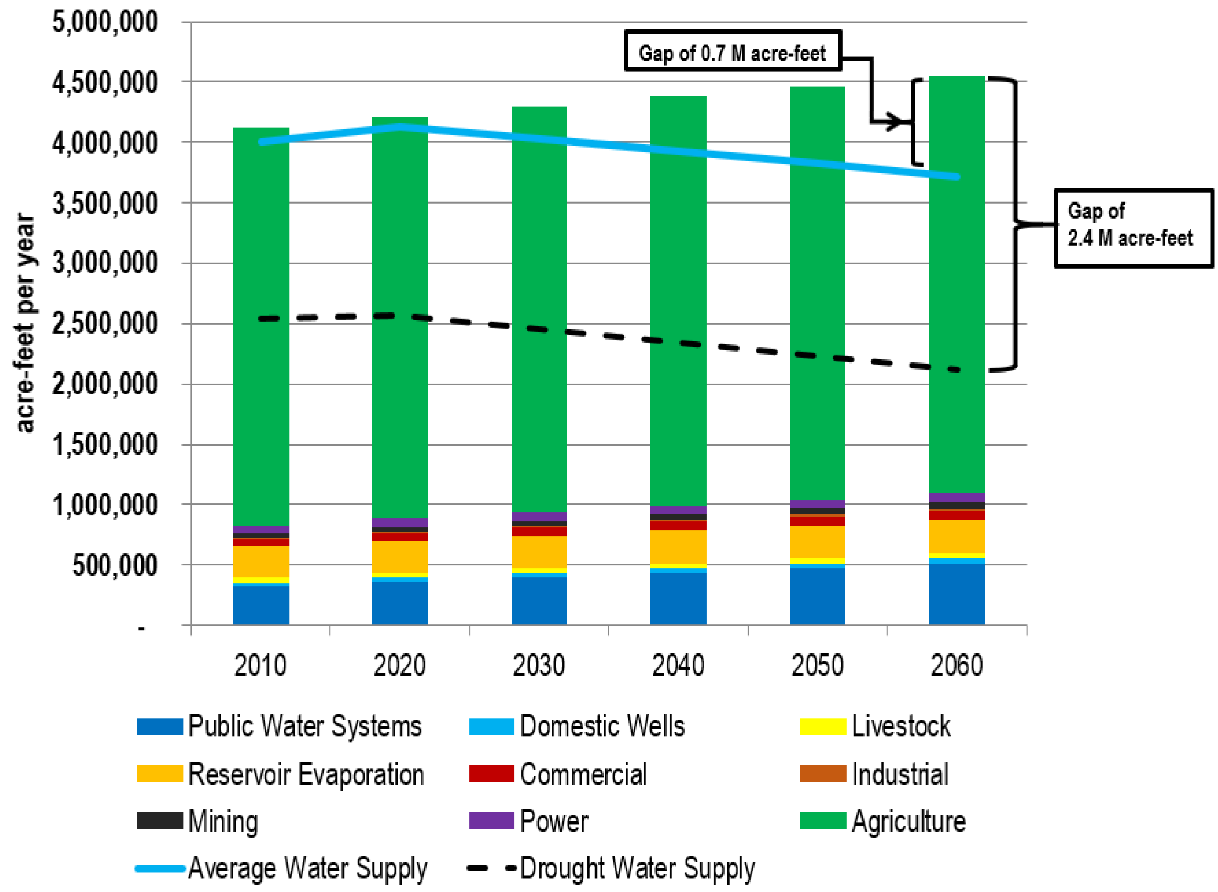

Figure 5-5. Supply and Demand under High Growth Projections for All Categories Statewide 2010-2060.

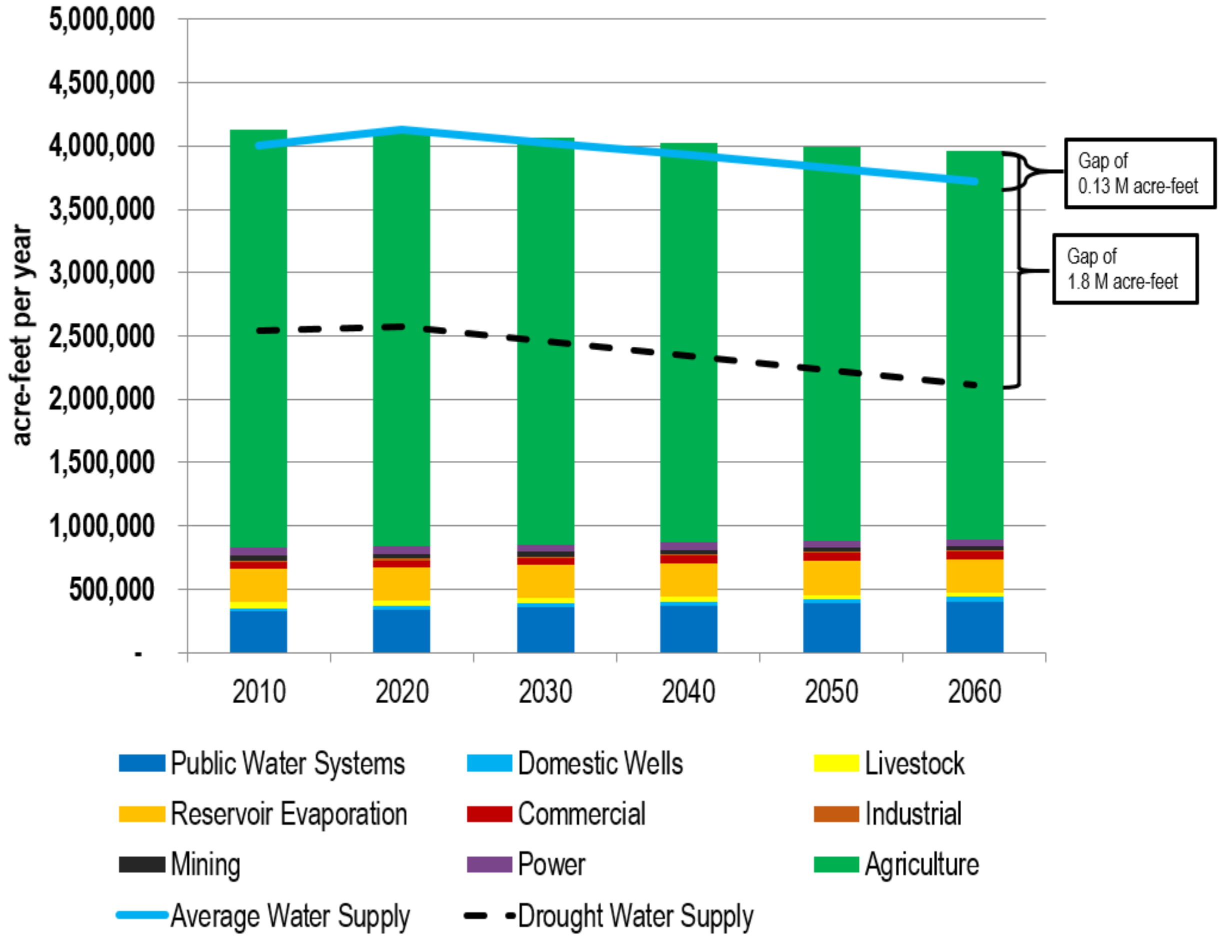

Figure 5-6. Supply and Demand under the Low Growth Projection for All Use Categories.

Figure 5-7 shows the details of the projected gaps between supply and demand by sector. The gap is calculated by subtracting the demand from the supply. The first stack shows the change in demand from 2010 to 2060 and is calculated by subtracting the demand in 2060 from the demand in 2010. The second and third stacks show the projected gap in an average water supply year and the drought-corrected scenario.

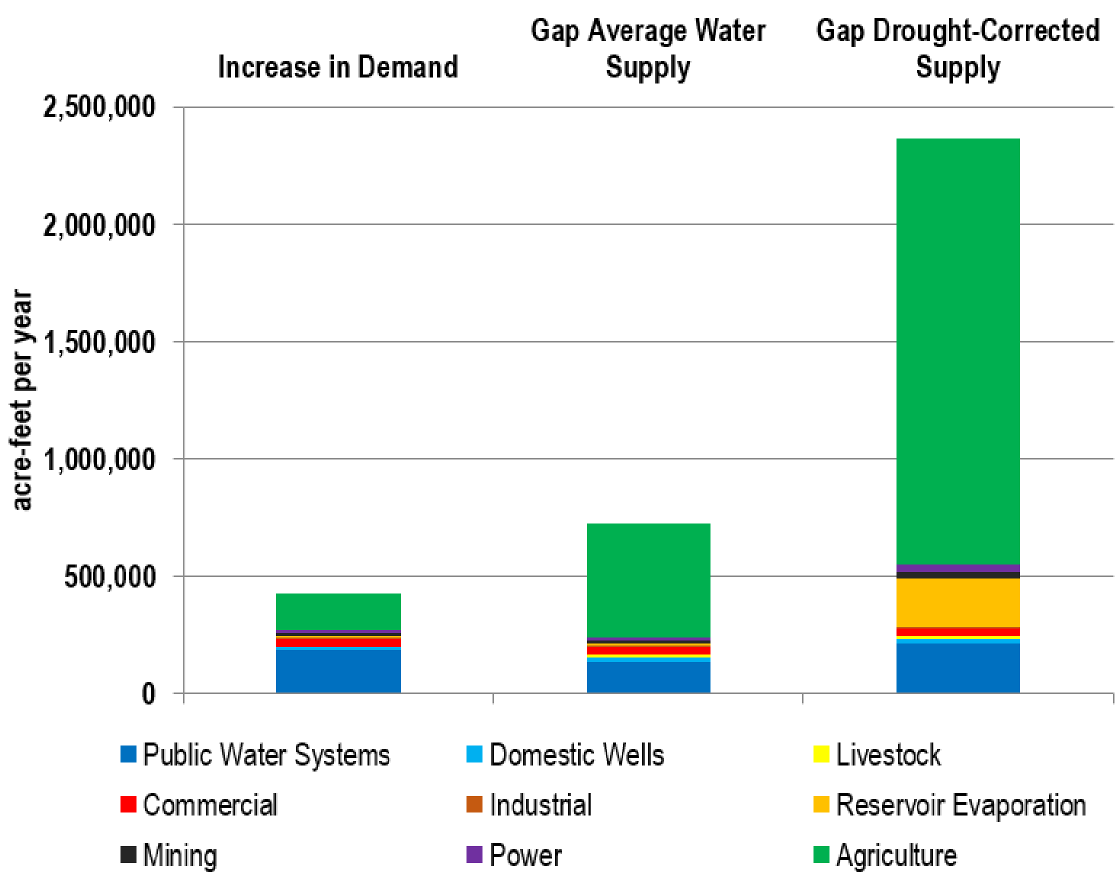

Figure 5-7. Statewide Summary of Increase in Water Demand and Gaps, with and without the Drought Correction in 2060, High Growth Projection.

5.3 SUMMARY OF SUPPLY-DEMAND GAP

In summary, for average water supply years and areas not dependent on mined aquifers, the outlook for meeting water demand appears much more manageable than the outlook under the drought-corrected scenarios or in areas dependent on non-stream-connected aquifers. While the agricultural category in many parts of New Mexico experienced the variability of supply throughout the history of irrigation, PWSs, particularly those dependent on surface water, will need to be prepared for the dry periods.

Some options are available for closing the gap, as discussed in Section 7 and Appendix 2C, such as water conservation, water supply projects, transferring water rights, and desalination. The summary of the supply-demand gap shown on Table 5-2 provides a general overview of the scale of the problem and the need to implement many of the proposed PPPs proposed by the regional water planning steering committees.

Table 5-2. Summary of Increase in Demand and Projected Water Supply Deficits by Sector Groupings in 2060.

Increase in Demand under High Growth Scenario	Water Supply Scenario	
	Average	Drought-Corrected
2010-2060	Deficit in 2060	
ac-ft/yr		
425,000	711,000	2,400,000

6. Summary of Key Water Issues: New Mexico Water Resource Challenges

New Mexico faces many challenges with providing reliable water supplies. During the 2016-2017 RWP update planning process, steering committee and stakeholder groups from around the state discussed key issues and challenges that affected their ability to secure long-term, reliable water supplies.

A total of 278 key issues for each region were collected based on input from regional stakeholders and steering committee meetings. While specific details regarding issues and potential solutions varied from region to region, many common themes emerged from the regional water planning process, which can be summarized in the following categories:

- Insufficient water supply
- Vulnerability to climate
- Water management
- Need for better understanding of water resources
- Water quality
- Water infrastructure and maintenance

This chapter summarizes the key issues described in each of the RWPs. The issues are interrelated and do not always fall neatly into a single category. Drought can create insufficient water supply and is one aspect of climate vulnerability for the state. Likewise, improved groundwater models that help provide a better understanding of water resources will also improve water management.

6.1 INSUFFICIENT WATER SUPPLY

Both surface and groundwater supply present unique challenges in securing future water supply. Surface water is renewable but highly variable both annually and seasonally; and whereas groundwater is often a reliable resource, in areas where recharge is much less than pumping, groundwater mining presenting a challenge for long-term sustainability. Population increases add stress to limited water supplies of PWSs and many of the PPPs (discussed in Section 7) are focused on reducing the gap between supply and demand.

In most parts of the state, the considerably lower surface water flows in drought years represent an important deficit in water supply. However, in some localities, such as Santa Fe and Albuquerque, conjunctive use plans have been implemented, allowing groundwater to be used in drought years and to be conserved in the wetter years. Conjunctive management and other strategies to address insufficient surface and groundwater supplies are discussed further in Section 7. Additional examples of efforts to ensure resiliency during drought include irrigation system efficiency improvements such as those completed by the Middle Rio Grande Conservancy District (MRGCD) in the 2000s and the shortage sharing agreement adopted by major water users in the San Juan Basin in 2003.

Another water supply project that will expand the supply for the agricultural water use sector is NIIP. NIIP is authorized for build out to irrigate up to 110,630 acres south of Farmington, but completion of the project will not likely occur until about 2040, given current rates of annual federal appropriations for project construction. The NIIP diverts water from Navajo Reservoir, and the annual diversion demand for the NIIP is anticipated to average about 353,000 ac-ft/yr at full buildout.

Insufficient surface water supply due to drought was a consistent issue identified in 14 out of 16 RWPs (Table 6-1) and is a concern in regions that are most heavily surface water dependent. Reservoir storage is a mitigating factor in some locations, but under long-term drought the supply in storage may be depleted.

Table 6-1. Summary of Types of Insufficient Supply Issues.

Insufficient Supply Issue	Number of Issues	Number of Regions with Issue (Out of 16)
Drought	28	14
Mined aquifers	13	9
Increasing demand due to population growth	7	5
Low-yielding aquifers	2	2

In general, groundwater provides a more stable and reliable water supply than surface water; however, in many locations groundwater pumping exceeds recharge, resulting in the decline of groundwater levels. Some wells can be re-drilled to deeper depths; however, local geologic conditions, and/or economic, or water quality issues in other areas limit accessibility to deeper groundwater resources. Some main areas that are affected by declining water levels and by limited alternative water supplies, as identified in their respective RWPs, include:

- The Ogallala/High Plains aquifer in the Northeast New Mexico and Lea County regions
- Portions of the Northwest New Mexico planning region (near Gallup)
- Portions of the East Mountain area of the Middle Rio Grande planning region
- Portions of the Estancia Basin planning region
- The Cienega area of the Jemez y Sangre planning region
- Parts of the Jornado del Muerto Basin in the Lower Rio Grande planning region

Water level declines have also affected water supply in the Maxwell area of the Colfax planning region, the Ojitos Frios area of the Mora-San Miguel-Guadalupe planning region, and the Magdalena area of the Socorro-Sierra planning region.

6.2 VULNERABILITY TO CLIMATE

In addition to the existing challenges presented by historically variable climate conditions, variable surface water supplies, and declining groundwater supplies, other potential effects of climate change that are likely to affect New Mexico water resources identified in the 2016-2017 RWP updates included increased temperatures, evaporation, and evapotranspiration; increased risks of drought and wildfire; earlier runoff; and increased risks of extreme precipitation events, as discussed in Section 3.1. These climate-change impacts were discussed in all 16 of the RWPs as part of the common technical approach. Additional specific climate vulnerability issues that were identified in the 16 RWPs are summarized in Table 6-2.

Table 6-2. Summary of Climate Vulnerability Issues.

Climate Vulnerability Issue	Number of Issues	Number of Regions (Out of 16)
Drought	28	14
Increasing demand due to increasing temperatures	2	2
Flooding/stormwater/sedimentation	12	11
Greater risk for catastrophic fires	9	9
Earlier runoff (and lack of storage)	1	1
Limitations on legal framework for water banking which could help address variability of climate	1	1

A major impact of ongoing climate change on water supply and availability is the timing each year of when peak snowmelt runoff occurs. The predicted change in peak snowmelt timing (1975-2040), for HUC 2 watersheds are shown in Figure 6-1. The change in peak snowmelt timing of up to three weeks earlier were derived by The Nature Conservancy (TNC, 2010).

Another significant impact of ongoing climate change is that warmer temperatures generally result in an increase in the vapor pressure deficit in the predominantly semi-arid climate of the American Southwest, which increases the vulnerability of forests to catastrophic wildfires and insect infestation (Williams et al., 2013). Vapor pressure deficit is a measure of the stress experienced by vegetation to increased temperature and decreased humidity.

Figure 6-2 shows (1) wildfires that have occurred in New Mexico forests from 1996 to 2017, (2) the PWSs dependent on surface water, and (3) the extensive efforts to thin forests to reduce the risk of catastrophic wildfires. PWSs that divert and treat surface water are particularly vulnerable to catastrophic fires due to the ash that clogs water treatment plant filter systems and the sediment carried by debris flows that reduces the storage capacity of reservoirs. Flooding, stormwater and sedimentation can impact water quality and the availability of water for all designated uses.

In the Jemez Mountains, the Cerro Grande fire in 2000 burned 48,000 acres, destroyed 400 homes in Los Alamos, and filled Los Alamos Reservoir with debris. The high severity Track fire in 2011 burned nearly 28,000 acres in Sugarite Canyon, the primary water supply for the City of Raton. The Las Conchas fire in 2011 burned 150,000 acres and once again threatened Los Alamos National Laboratory and the town of Los Alamos and became the largest fire in New Mexico’s history at that time. The Las Conchas fire also burned over 16,000 acres on Santa Clara Pueblo and the post-fire impacts led to the issuance of five Presidential Disaster Declarations at the Pueblo. Wildfires since 1998 have destroyed over 80% of the Pueblo’s forest lands. In 2012, the Whitewater-Baldy Complex fire surpassed the Las Conchas fire, burning almost 300,000 acres, most of it contained within the Gila Wilderness.

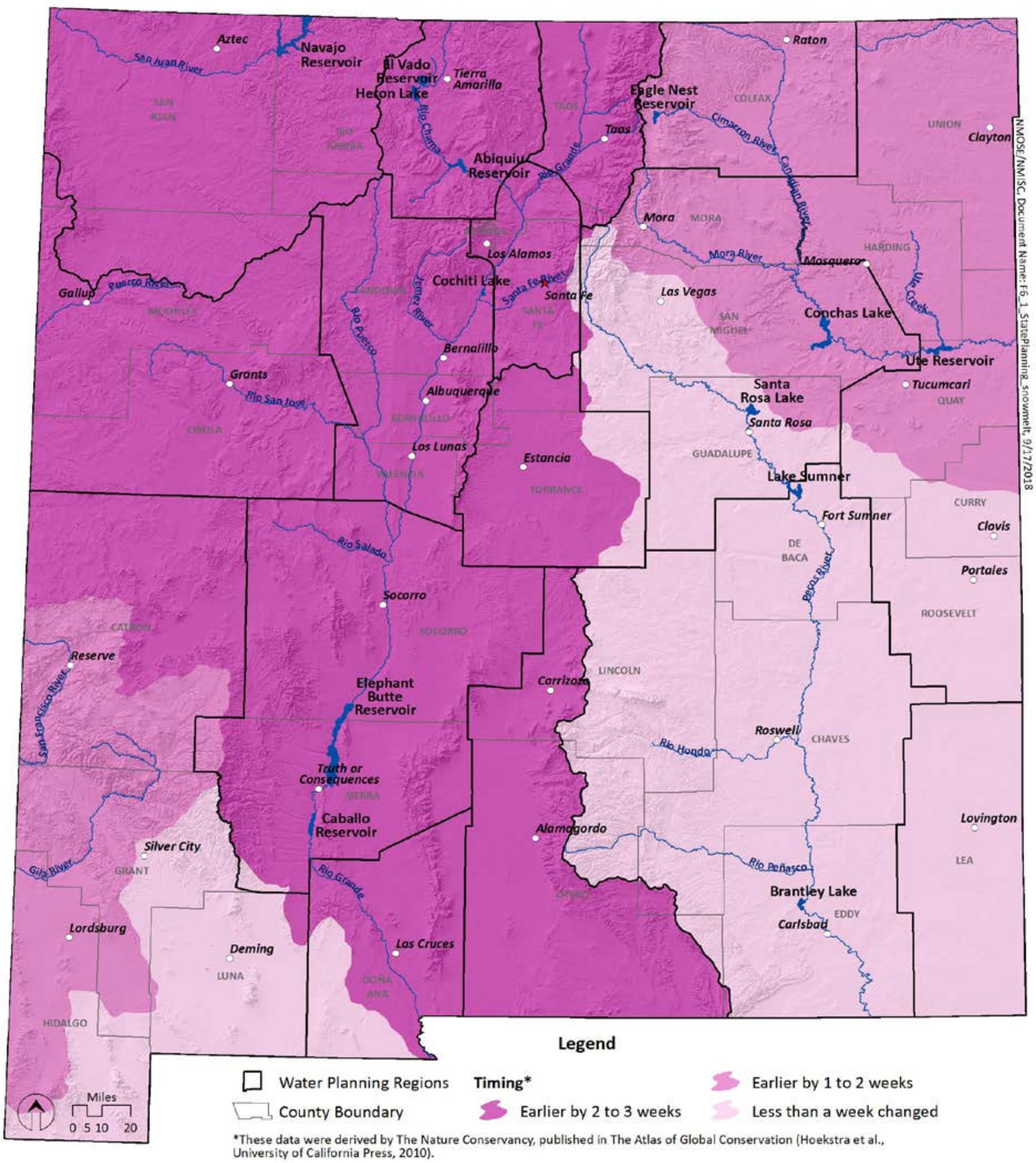

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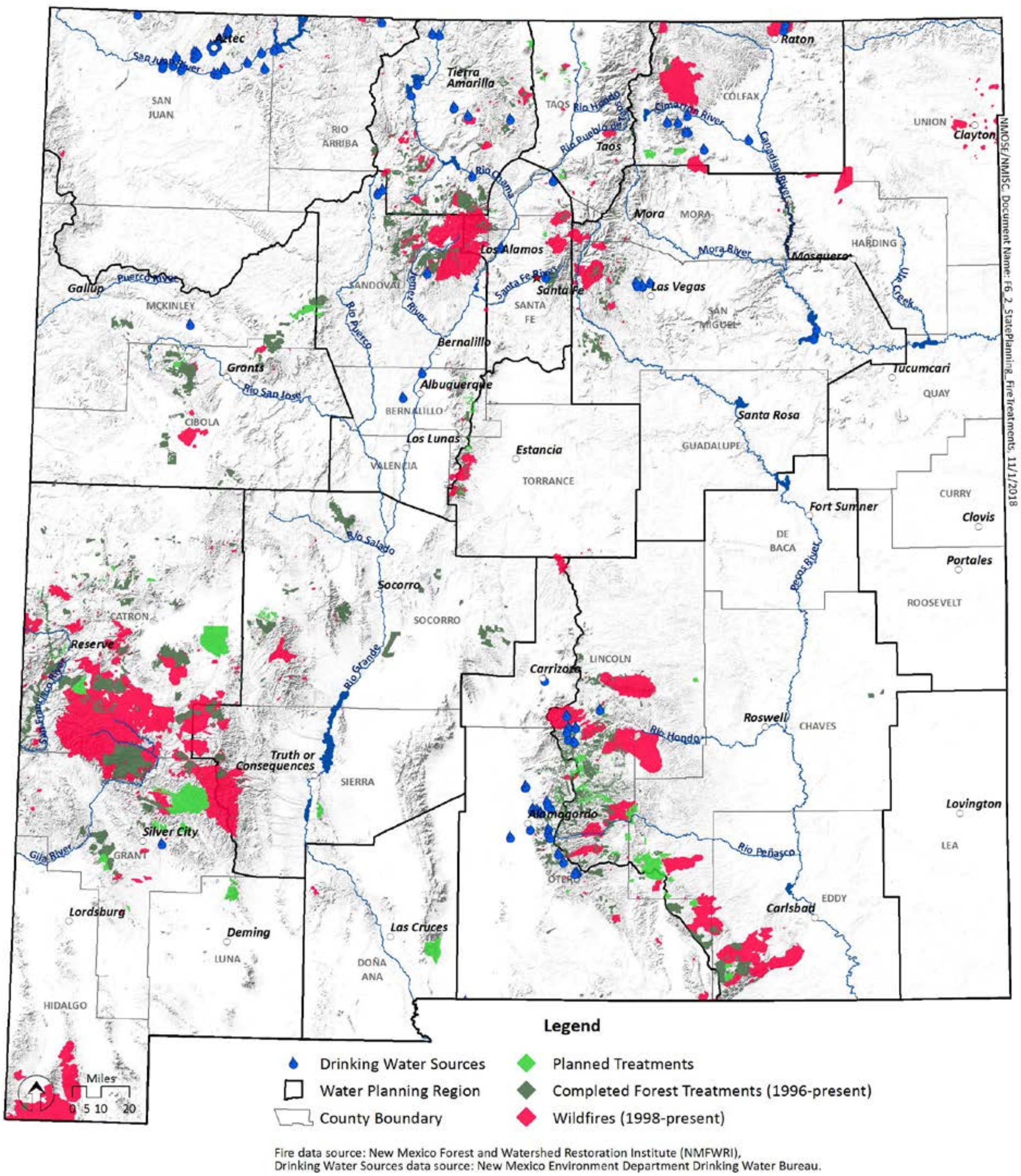
Figure 6-1. Predicted Changes in Peak Snowmelt Timing from 1975 to 2040.



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NM Interstate Stream Commission

Figure 6-2. Forest Treatments, Forest Fires, and Public Water Systems Supplied by Surface Water in New Mexico.

6.3 WATER MANAGEMENT ISSUES

Legal and policy issues that guide water resource administration and provide a framework for water management in New Mexico were identified in 13 out of 16 regions. The RWPs identified Interstate Compacts, water rights adjudications, and water right transfers, Endangered Species Act compliance, and other legal and policy issues governing administration of water resources that constrain their ability to utilize supplies available within their regions, as summarized in Table 6-3.

One region raised the issue of the increase in water demand as farmers shift from low- to high-water demand crops without acquiring more water rights. Issues about impairment to senior water rights were raised in several regions due to depletion from domestic wells upstream of springs, oil and gas development in the Lower Pecos Valley planning region, increase in salinity from high levels of pumping in the Lower Rio Grande, and other issues related to operating agreements.

Table 6-3. Summary of Water Management Issues.

Water Management Issue	Number of Issues	Number of Regions (Out of 16)
Water rights transfers	17	9
Interstate compact compliance	13	8
Impaired senior water rights from domestic wells, oil and gas development, operating agreements, groundwater pumping in Texas	9	6
Environmental flows	8	8
Incomplete adjudications	9	6
Reservoir operations	6	4
Out-of-basin transfers	5	5
Critical management areas	3	3
Increasing water demand due to changing cropping patterns	1	1

New Mexico water law governs water management, as outlined in *State Water Plan Part III: Legal Landmarks*. In the state water planning process, a variety of issues regarding water rights transfers were identified; including implementing recently completed water rights settlements, concerns about large development projects or water rights transfers moving water or water rights away from basins or regions of origin, concerns about protecting senior water rights in the transfer process, and concerns about legal mechanisms for establishing or maintaining environmental flows. Some regions noted the importance of completing adjudications so that water rights are defined.

One of the key issues for the Middle Rio Grande planning region is the availability of water rights. No new appropriations are available in the region (and other portions of the Rio Grande Basin). After the groundwater basin was closed to new appropriations in 1956, several entities applied for and were issued groundwater pumping permits with the condition that the effects of the pumping on the river would be offset when they occur.

Municipal return flow, San Juan-Chama Project water, and the transfer of senior water rights are used as offsets as required by the specific permit requirements, with return flows comprising the greatest volume of offset. If all these permits are fully exercised, the amount of senior water rights needed to offset the effects of groundwater pumping on the Rio Grande is roughly equal to all the transferrable senior water rights from the irrigated land along the Rio Grande from north of Albuquerque to Elephant Butte (Schmidt-Petersen, 2011). Many of the municipal water systems have retained the needed rights, and under an average water supply year, water demand is met. The communities of Albuquerque and Santa Fe have in recent years reduced their dependence on groundwater, changing the projected impacts on the Rio Grande.

Interstate compacts on the Canadian River, Pecos River, Rio Grande, and the Colorado River Basin constrain water use and management and affect strategies for meeting demand in much of New Mexico. The regional plans also identified issues related to court decisions and programs related to the Endangered Species Act and other environmental programs that affect water management activities. Figure 6-3 shows the critical habitat for endangered species in New Mexico that impact water management throughout the state.

Recommendations included in the regional water plans for establishing critical management areas or other administrative guidelines by the OSE were directed at protecting groundwater resources and senior water rights, or in some cases existing guidelines were noted as constraining water resource development.

The ability to develop new sources, particularly in stream-connected basins where water rights are fully appropriated creates a planning challenge, identified in several RWPs. In many areas any new diversion of surface water or stream-connected groundwater requires the transfer of a valid water right (aside from small individual diversions from new domestic or livestock wells), and the transfer is limited to the consumptive use portion of that right. The availability of water rights may thus be a limiting factor in meeting the future water needs of the regions.

The State Water Plan Act at Section C (8) states that the plan shall "promote river riparian and watershed restoration that focuses on protecting the water supply, improving water quality and complying with federal Endangered Species Act of 1973 [16 U.S.C. §1531 et seq.] mandates." In 2005, NMSA 1978 §72-14-3.3 gave the ISC the authority to establish the strategic water reserve to purchase or lease water or water rights to help comply with interstate stream compacts and court decrees, and also to assist the state and water users in water management efforts for the benefit of threatened or endangered species. To date, a total of 2,748 ac-ft of water rights have been acquired by ISC on the Middle Rio Grande and Pecos River and placed into the reserve.

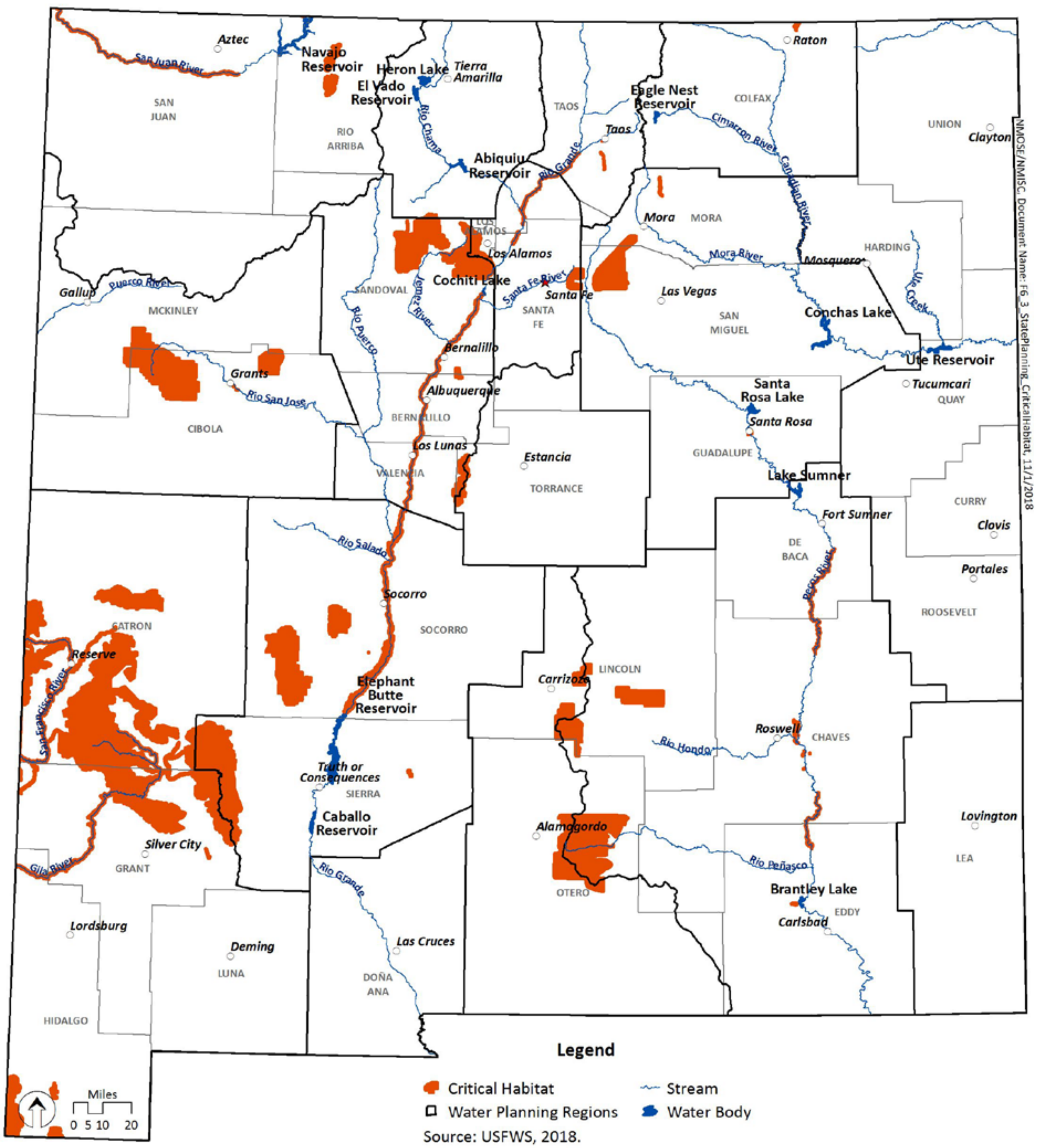


Figure 6-3. Critical Habitat for Endangered Species in New Mexico.

6.4 BETTER UNDERSTANDING OF WATER RESOURCES

Eleven out of 16 water planning regions identified needs for additional data collection and monitoring, modeling, and analyses to better inform water resource decisions and policies regarding sustainability or longevity of groundwater resources. Issues regarding the need for better understanding of water resources identified in the 2016-2017 RWP updates are summarized in Table 6-4.

Table 6-4. Summary of Issues Related to Better Understanding of Water Resources.

Understanding Water Resources Issues	Number of Issues	Number of Regions (Out of 16)
Aquifer mapping to identify alternative water sources	8	6
Improved groundwater models for water rights administration and management	5	4
Aquifer decline, volume in storage, recharge rate, amount pumped needs to be better understood	4	3
Impact of vegetation management on stream flow and recharge	3	3
Quantification of water budget	3	2
Monitoring needed to better manage resources	2	2

As many planning regions struggle with drought and declining water levels, as well as the pressure of increased future demands in some areas, the need for a better understanding of potential new water resources was a common theme, and the 2016-2017 RWP updates showed widespread support for aquifer mapping that can help to inform decisions about potential alternative water supplies. For example, the Colfax planning region has actively been seeking funding for aquifer mapping to identify alternative groundwater supplies to the drought-vulnerable surface supplies in the region.

Like the need for aquifer mapping, groundwater studies that provide more quantitative information on rates of groundwater decline and other aquifer impacts are important for understanding the sustainability of groundwater resources and can be used to develop improved groundwater models for water rights administration and management. Competition for water resources creates tension and the need to understand the impacts of one water user on another; and, as the Jemez y Sangre planning region recommended, an updated administrative groundwater model is needed to better manage the aquifers and their connection to surface water. In the Estancia Basin planning region, critical information needed to better understand the water resources includes the connection between the Madera Group and Valley Fill aquifers, the potential for subsidence in the Valley Fill, and migration of water from area of high salinity to areas of lower salinity.

Several regions noted that though forest restoration efforts have helped to reduce the risk of wildfire, the net water supply impacts of physical watershed management techniques are not well documented or understood. Quantification of the effectiveness of riparian vegetation removal, upland conifer thinning, and other water salvage methods need further study and continued monitoring and will be crucial to understanding the role vegetation management plays on water budgets.

6.5 WATER QUALITY

Water quality was highlighted as an issue in 14 out of 16 water planning regions, an issue that in many cases results in additional limitations on water supplies. Many regions identified protecting and/or improving water quality as important; some of the key issues and challenges identified in the 2016-2017 RWP updates regarding water quality are summarized in Table 6-5.

Table 6-5. Summary of Water Quality Issues.

Water Quality Issue	Number of Issues	Number of Regions (out of 16)
Naturally occurring salinity, uranium	12	6
Surface and groundwater contamination from septic tanks	7	7
Groundwater contamination from mining and industry	6	6
Hydraulic fracturing	5	5
Degraded riparian area/need for restoration	4	4
Mercury in lakes/fish	3	3
Water quality issues in stormflows	2	2
E. coli in surface water	2	2
Surface water supplies contaminated from industry	2	2

Potential contamination of shallow groundwater, domestic wells, and in some locations surface water due to septic tanks is a concern in many rural areas in New Mexico. E. coli was specifically mentioned in two regions where high levels were detected in the Rio Grande and the San Juan and Animas rivers due to human and wildlife waste products. The RWPs also identified water quality protection and/or restoration from leaking underground storage tanks (USTs), agricultural activity and dairy operations, existing or proposed mining operations, and contamination from oil and gas field operations as important issues. Several regions noted that high levels of mercury detected in fish and the resulting fish consumption advisories for many reservoirs in New Mexico were significant water quality issues. The source of the mercury is most likely atmospheric deposition.

The 2016-2017 RWP updates also noted that increasing temperatures and evaporation rates can affect water quality. Concentrations of nitrogen, phosphorus, suspended solids, and salts may increase in the future in response to increased surface water evaporation rates and increased precipitation intensity. In addition, higher water temperatures can lead to less dissolved oxygen, which is a problem for many aquatic species.

Sedimentation is a key challenge for many water suppliers. During rain and flood events, both ephemeral tributaries and perennial water courses contribute substantial amounts of sediments into the rivers. Post-fire sedimentation and extreme precipitation events exacerbate the issue. Sedimentation and erosion issues contribute to degraded riparian areas.

High concentrations of dissolved solids (brackish water) as well as naturally occurring uranium, arsenic, and fluoride in groundwater in many locations requires treatment prior to use of the water, creating an economic barrier for use of those supplies in many cases.

6.6 WATER INFRASTRUCTURE AND MAINTENANCE

Maintaining, improving, and managing PWSs and agricultural infrastructure is one of the greatest funding challenges in New Mexico, an issue raised in 15 out of 16 water planning regions. Of the approximately 1,400 water systems that provide drinking water in New Mexico; more than 500 of those systems serve less than 100 people. In addition to the drinking water systems, thousands of small acequia/irrigation systems in New Mexico are also challenged with infrastructure issues.

Though not all regions listed specific infrastructure issues in their key issues, hundreds of infrastructure needs were identified, including dam safety issues. Therefore, this list is not inclusive of all infrastructure needs identified in the 2016-2017 RWP updates. Infrastructure challenges that were highlighted as key issues are summarized in Table 6-6.

Most of the regions identified issues with small drinking water systems, including many small systems such as mutual domestic water consumer associations and mobile home parks. Many of these systems have issues with aging infrastructure, maintenance, upgrades, training, operation, and monitoring that is required to ensure delivery of water that meets drinking water quality standards. For example, in the Taos planning region, achieving optimal efficiency in water system operation and infrastructure upgrades (through cooperative associations or other means) was identified as an important objective. Larger communities also identified extensive lists of infrastructure projects, and 14 large water projects were noted in the regional water plans.

Table 6-6. Summary of Water Infrastructure Issues.

Water Infrastructure Issues	Number of Issues	Number of Regions (out of 16)
Small public water systems	15	12
Public water system operations and maintenance	7	4
Large water projects	14	8
Wastewater	5	4
Sedimentation in reservoirs (loss of capacity)	5	5
Acequias	4	4
Agricultural irrigation	4	4
Dam safety	2	2
Regionalizing water systems	1	1
Flood control infrastructure	1	1

Flood control infrastructure along the Rio Grande (particularly in the Middle Rio Grande and Lower Rio Grande regions) is a significant issue. Most of the existing flood control infrastructure along the Rio Grande between Espanola and Truth or Consequences is many decades old and nearing the end of its useful life. This flood control infrastructure in most instances consists of levees which were not designed to engineering standards, but instead consist simply of excavated material placed alongside the river.

In many areas, due to sediment buildup along the bottom of the channel of the Rio Grande, the river is higher than the surrounding floodplain, and failure or breach of a levee would cause significant flooding. The cost to replace or reinforce the levee system throughout the Middle Rio Grande valley is estimated at more than $750 million. Also, in the Lower Rio Grande planning region, the United States section of the International Boundary and Water Commission (USIBWC) maintains a flood control system of levees along the length of the Rio Grande in New Mexico downstream of Caballo Reservoir.

In recent years, USIBWC has designed and built levees along the Rio Grande in New Mexico to meet Federal Emergency Management Agency (FEMA) levee accreditation requirement (44 CFR 65.10), including 3 ft of freeboard above base flood level (100-yr flood). Currently, USIBWC is in the process of constructing the remaining levees and floodwalls near Sunland Park and Canutillo to complete the system. All the constructed levees await accreditation by FEMA, pending interior drainage studies by local authorities.

Dam safety issues were summarized in each of the RWPs. Six regions have identified dam repair in their PPP lists, but only two regions listed dam safety as a key issue. The City of Raton in the Colfax planning region is faced with a major infrastructure issue. The spillway at Lake Maloya is only 9% of the required size to route governing inflow design.

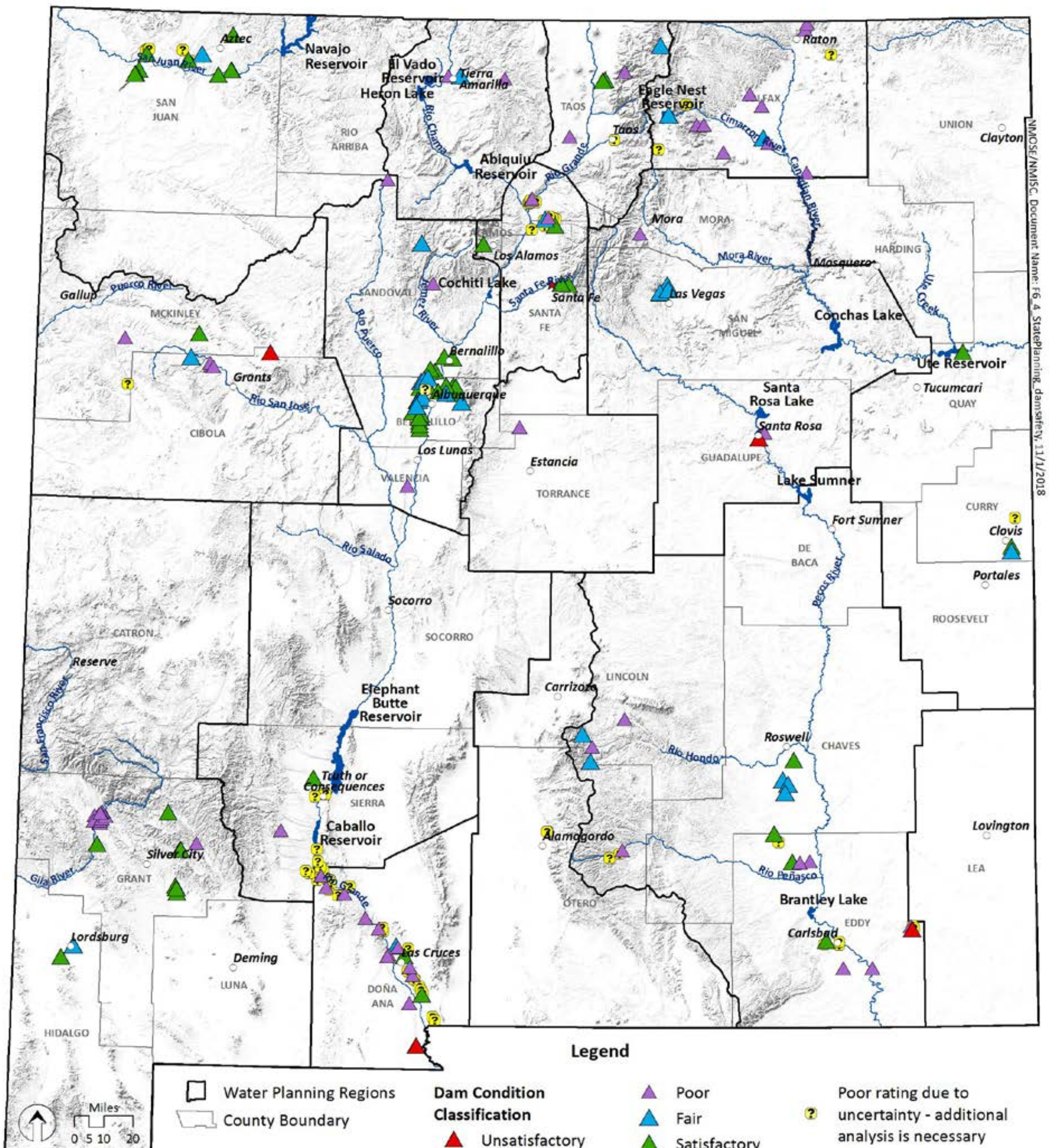
Figure 6-4 shows the condition of dams with high or significant hazard potential ratings in New Mexico. The OSE Dam Safety Bureau database identifies 170 dams with a high hazard potential rating, and 50 dams with a significant hazard potential rating that are under state jurisdiction.

The hazard rating is different than the condition rating, which as the name indicates, is an assessment of the condition of the dam. Dams with a high hazard rating are those where failure or faulty operation would likely result in loss of human life. Those with a significant hazard rating are those were failure or faulty operation would likely not result in loss of human life but could cause economic loss, environmental damage, disruption of lifeline facilities, or could impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but may be in populated areas with significant infrastructure.

Dams with an unsatisfactory condition rating require immediate or remedial action. Some dams receive a “poor” condition rating if comprehensive design information is not available. Based on the hazard potential rating and condition of the dams, more regions may want to add dam safety as a key issue in future water planning efforts.

Three dams stand out as serious problems based on their high hazard potential rating and unsatisfactory condition. In the Northwest New Mexico planning region, in Cibola County, San Mateo Lake Dam is classified as unsatisfactory due to the inadequate spillway capacity, which is 27% of the inflow design flood, embankment, cracking, severe seepage, and an overall lack of maintenance. In Guadalupe County, Power Lake Dam is classified as unsatisfactory due to an undersized spillway, with a capacity of only 11% of the design flood, and due to the partially breached condition of the dam. In Doña Ana County, Gardner Dam has no spillway or low-level outlet, has severe erosion, excessive encroachment of woody vegetation and excessive seepage.

The preservation of traditional communities, agriculture, and the historical acequia system continues to be a key issue in several parts of the state. Funding for repair and maintenance of acequia infrastructure is an ongoing issue, and the New Mexico Acequia Association has identified hundreds of projects needing funding. In some areas agricultural efficiency was the most mentioned issue. In the Colfax planning region where there is little shallow groundwater benefitting from ditch seepage losses, ditch losses are a key issue. Water seeping from ditches in the Colfax region does not return to the stream or recharge a viable aquifer.



Source: OSE, 2017.

Figure 6-4. Condition of State Regulated and Non-Federal Dams in New Mexico with Significant or High Hazard Potential.

7. Strategies for Addressing Key Water Issues

Regional steering committees identified and compiled lists of potential water PPPs (projects, programs, and policies) as strategies for implementation to address key water planning issues in their respective regions. At steering committee meetings held in 2015 and 2016, each group discussed projects that would have a larger regional or sub-regional impact and for which there is interest in collaboration to seek funding and for implementation. Each region used different methods of categorizing their PPPs. For purposes of comparing "apples to apples" in this State Water Plan, each PPP was assigned to a category with consistent names (i.e. Watershed Restoration instead of Forest Restoration; Riparian Restoration instead of River Restoration), and each was categorized based on one of eight strategy purposes, summarized below with examples:

Improve System Efficiency: Changes to existing infrastructure for agricultural and PWSs and wastewater systems; increasing storage of reservoirs; water banking; canal lining; water planning.

Protect Existing Supplies: Improvements to current wastewater systems (replacing septic tanks) to protect water quality; watershed and riparian restoration, dam safety; stormwater system infrastructure, environmental flows, erosion control; water planning; water quality protection; water quality treatment of existing supplies; water rights protection.

Increase Water Supply: Projects that would result in a reduction in the predicted gap between supply and demand (for non-agricultural sector) by increasing the amount of water available to a water system such as underground storage and recovery (USR); projects that utilize water otherwise not relied upon by the water system; desalination of water (including produced water from oil & gas) that is not otherwise associated with a declared groundwater basin such that use of the water would not impact existing water rights; drilling new wells that expand the capacity of the water supply; importing water from another groundwater basin or surface water supply; return flow credit for treated effluent that was not otherwise utilized by the water system; transferring water rights (through purchase, lease or water banking) from agriculture to municipal and industrial; Using treated effluent for USR projects; community cisterns.

Reduce Demand: Projects that would result in a reduction in the predicted gap between supply and demand (for non-agricultural sector) by reducing the current or predicted demand such as all water conservation programs for PWSs (audits, fixing leaks, rebate programs, roof catchment); water conservation for agricultural systems where the project does not increase the consumptive use such as lining ditches where the water seeped into a deep unsaturated zone or laser leveling that reduces the incidental depletions of on-farm irrigation; metering wells or changes in crops or irrigation methods; reducing evaporative losses, using treated effluent instead of potable water on turf or other landscaping.

Improve Understanding of Water Resources: Data collection/hydrologic studies including groundwater and geologic mapping, database & global information system (GIS) development, groundwater models, water quality testing, water level monitoring, weather data collection; water planning.

Drought Mitigation: Projects or programs that provide temporary solutions to a drought emergency, such as shortage sharing agreements, emergency drought restrictions for public water supplies, drilling back-up wells, conjunctive use strategies to rest the aquifer and rely on renewables when available, thereby increasing the capacity of the well fields; water banking rather than a permanent transfer of water rights to address the temporary shortage.

Public Outreach/Stakeholder Involvement: Development of water authority or water board, programs to pursue implementation of projects such as water conservation; public education about any aspect of water planning, improving relationships.

Water Policy: Policies that address management of water resources including economic strategies, restrictions on water use.

Nearly 50 categories of strategies were identified in the PPP lists, and some of the categories fall under multiple purposes, creating a challenge for categorizing and summarizing the lists. For instance, "water conservation" is most often implemented for reducing the overall demand of the water system, but it can also be implemented as a drought mitigation measure. The proposed projects with the purpose of reducing water demand or increasing water supply to address the supply-demand gap are described in more detail in Appendix 2C.

The degree to which each strategy will reduce the demand or increase supply was not included in the 2016-2017 RWP updates (except for Jemez y Sangre). However, for this *2018 New Mexico State Water Plan*, an estimate of the reduction in demand in the PWS sector for each region is calculated based on one of many possible scenarios. The total potential savings for the 1.7 million people who are served by PWSs statewide is 66,000 ac-ft/yr, if demand were reduced to 130 gallons per capita per day (gpcd) in areas where it is presently higher (see Appendix 2C.1 for details). Water conservation PPPs proposed for other water use sectors are briefly described in Appendix 2C.1.2 through 2C.1.5.

Appendix 2C.2 describes PPPs to increase water supply proposed by the regions that involve developing new sources of water supply. Appendix 2C.3 describes actions related to transferring water rights, and Appendix C.4 addresses inter-basin transfers of water. And finally, Appendix 2C.5 discusses mitigating drought through reducing conflict with shortage sharing agreements.

7.1 KEY COLLABORATIVE STRATEGIES

To determine which projects might have the most momentum for implementation, the steering committee members identified PPP leads and partners as well as possible funding sources. The PPPs that lend themselves to collaboration are focused primarily on protecting existing supplies and improving understanding of the water resources, as shown in Table 7-1. Projects such as stormwater protection, watershed restoration, riparian restoration, data collection, and improved models are projects that stakeholders can collaborate on and benefit everyone. Table 7-2 shows a summary of the types of key collaborative projects identified by the regions.

Table 7-1. Summary of Key Collaborative Strategies by Purpose from the 16 Regional Water Plans.

Strategy Purpose	Total	Number of Regions
Protect existing supplies	55	15
Improve understanding of water resources	42	15
Reduce demand	21	9
Improve system efficiency	21	12
Increase water supply	10	6
Water policy	6	4
Public outreach/stakeholder involvement	6	4
Drought mitigation	6	4
Total	167	

Table 7-2. Summary of Key Collaborative Strategies by Subject from the 16 Regional Water Plans.

Strategy	Total PPPs	Number of Regions
Data collection/hydrologic studies	37	15
Watershed restoration	29	14
Water system infrastructure (M)	13	10
Water conservation (M)	12	8
Water planning	9	6
Riparian restoration	8	5
Water conservation (A)	8	7
Stormwater system infrastructure	7	7
Wastewater reuse	6	5
Water system infrastructure (A)	6	4
Create water authority/board	4	2
Water banking	3	3
Increase storage	3	2
Water rights protection	3	3
Water quality protection	2	2
Reservoir management	1	1
Desalination	1	1
Drill new well	1	1
Economic strategy	1	1
Environmental protection	1	1
Implementation	1	1
Dam safety	1	1
Import/export water	1	1
Metering	1	1
Policy recommendations	1	1
Produced water (oil & gas)	1	1
Underground storage and recovery	1	1
Protect water rights	1	1
Transfer water rights	1	1
Wastewater system infrastructure	1	1
Water treatment system (M)	1	1
Protect agriculture	1	1

Notes:
M = Municipal
A = Agriculture

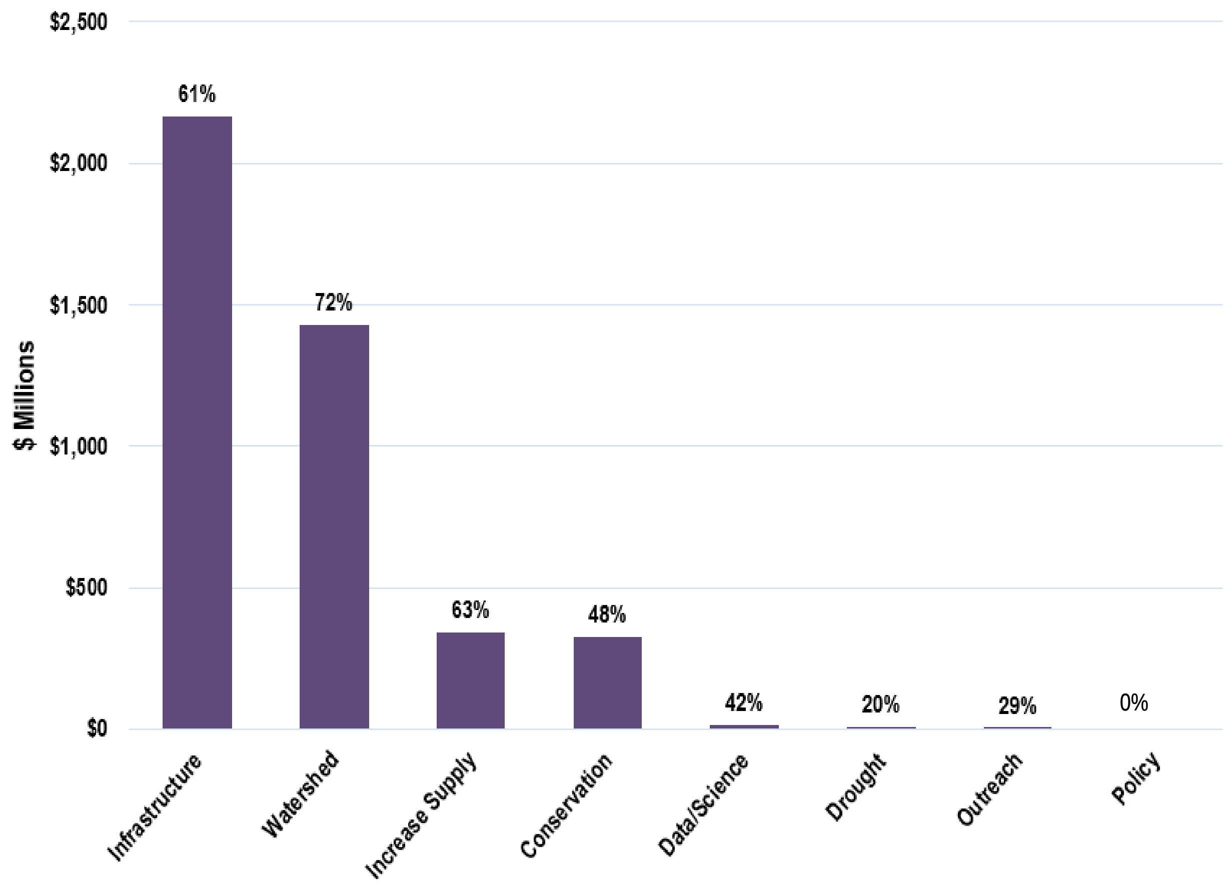
7.2 ALL PROJECTS, PROGRAMS, AND POLICIES

In addition to identifying key collaborative efforts, each region discussed and compiled a list of PPP needs. Information was requested during several open meetings, and requests for input were also emailed to all stakeholders who had expressed interest in the regional water planning process. Some water projects included on the PPP lists were already identified through the State of New Mexico Infrastructure Capital Improvement Plan (ICIP) process or other planning processes. The PPPs included water system infrastructure, acequia infrastructure, watershed management, water conservation, data collection projects, and other types of projects. The complete list of PPPs is appended to each RWP, available at http://www.ose.state.nm.us/Planning/regional_planning.php.

The 2,635 PPPs from the 16 regions are summarized in Table 7-3 based on the purpose of the strategy. About 62% of the PPPs included a cost estimate (Figure 7-1). Most of the projects by cost and number are for water or wastewater system infrastructure for both public and agricultural water systems to improve operations and efficiency. Protecting existing supplies, particularly through watershed restoration and stormwater protection, also represents many of the projects. Of the 62% of PPPs that provided costs, the total for all proposed projects and programs for the fiscal years 2018 through 2020 exceeds $4 billion. As shown in Table 7-4, about 50 strategy types were identified in the PPP lists, which shows again that the clear majority of projects and costs are for various infrastructure projects.

Table 7-3. Summary of Projects, Programs, and Policies from 16 Regions.

Strategy Purpose	Total Cost	Number of PPPs	PPPs with Cost	Percent of PPPs with Cost Provided
Improve system efficiency	$2,166,164,000	1412	868	61%
Protect existing supplies	$1,429,200,000	705	509	72%
Increase water supply	$342,528,000	135	85	63%
Reduce demand	$326,811,000	180	87	48%
Improve understanding of water resources	$13,941,000	151	64	42%
Drought mitigation	$10,350,000	15	3	20%
Miscellaneous	$4,391,000	6	3	50%
Public outreach/stakeholder involvement	$1,017,000	17	5	29%
Water policy	NA	14	0	0%
Total	$4,294,402,000	2635	1624	62%



Note: Percentage values represents the percentage of projects that provided a cost estimate in the regional water plans for each category.

Figure 7-1. Summary of Estimated Costs by Projects, Programs, and Policies.

Table 7-4. Summary of Strategy Costs for All Projects, Programs, and Policies.

Strategy	Total Cost	Number of PPPs	Percent with Costs Estimates Provided
Water System Infrastructure (M)	$1,800,500,000	808	84%
Wastewater System Infrastructure	$917,005,000	256	90%
Water System Infrastructure (A)	$382,520,000	531	24%
Stormwater System Infrastructure	$360,459,000	138	80%
Wastewater Reuse	$173,461,000	50	72%
Riparian Restoration	$151,635,000	61	64%
Watershed Restoration	$142,698,000	233	62%
Drill New Well	$69,581,000	55	80%
Dam Safety	$58,915,000.	19	58%
Water Treatment System (M)	$53,237,000	41	78%
Water Conservation (M)	$49,766,000	58	40%
Transfer Water Rights	$26,499,000	27	70%
Desalination	$17,390,000	9	22%
Metering	$13,392,000	43	63%
Increase Storage (A)	$11,000,000	3	67%
Regional Water System	$10,900,000	2	50%
Regional Wastewater System	$10,000,000	1	100%
Dam Rehabilitation	$9,000,000	2	50%
Data Collection/Hydrologic Studies	$8,646,000	109	39%
Water Planning	$6,420,000	63	44%
Uncategorized	$4,391,000	3	100%
Reservoir Management	$4,050,000	2	50%
Increase Storage	$4,000,000	4	25%
Produced Water (Oil & Gas)	$3,500,000	3	33%
Water Conservation (A)	$2,300,000	29	10%
Water Banking	$1,200,000	7	29%
Water Rights Protection	$581,000	11	45%
Create Water Authority/Board	$500,000	5	20%
Education	$255,000	7	29%
Shortage Sharing	$250,000	2	50%
Cloud Seeding	$150,000	6	17%
Environmental Flows	$100,000	2	50%
Drill New Well (A)	$52,000	1	100%
Metering (A)	$30,000	4	25%
Water Quality Protection	$20,000	10	20%
Policy Recommendations	NA	8	0%
Underground Storage and Recovery	NA	4	0%
Environmental Protection	NA	3	0%
Import/Export Water	NA	3	0%
Reduce Evaporation Losses	NA	3	0%
Implementation	NA	2	0%
Import Water	NA	2	0%
Protect Agriculture	NA	2	0%
Economic Strategy	NA	1	0%
Industrial Water Reuse	NA	1	0%
Protect Water Rights	NA	1	0%
Return Flow Credit	NA	1	0%
Water and Wastewater System Infrastructure (M)	NA	1	0%

Notes:
M = Municipal, A = Agriculture, NA = not available

The estimated costs for the PPPs by region are shown in Table 7-5. The clear majority are for infrastructure projects for public water and wastewater systems ($3.1 billion) and agricultural irrigation systems ($394 million). Figure 7-2 shows the distribution of need for financial resources for public water and wastewater infrastructure projects for 83% of the projects (those which included costs). Some regions may be further along in their planning efforts and better able to identify the projected costs for implementing projects.

The costs by region for 20 specific strategies are listed in Table 7-6. Figure 7-3 shows the distribution of estimated costs for agricultural infrastructure projects for the 25% that included costs.

Table 7-5. Summary of Projects, Programs, and Policies Costs by Region.

Planning Region Number	Region Name	Total Cost	Number of PPPs	Percent with Cost Estimate
1	Northeast New Mexico	$184,778,000	99	20%
2	San Juan Basin	$333,398,000	154	84%
3	Jemez y Sangre	$266,266,000	206	76%
4	Southwest New Mexico	$149,851,000	260	75%
5	Tularosa-Sacramento-Salt Basins	$331,941,000	101	45%
6	Northwest New Mexico	$586,802,000	205	72%
7	Taos	$123,663,000	279	38%
8	Mora-San Miguel-Guadalupe	$263,381,000	337	39%
9	Colfax	$216,633,000	116	89%
10	Lower Pecos Valley	$287,383,000	161	60%
11	Lower Rio Grande	$524,568,000	288	74%
12	Middle Rio Grande	$564,467,000	178	50%
13	Estancia Basin	$145,712,000	33	91%
14	Rio Chama	$168,785,000	109	79%
15	Socorro/Sierra	$20,064,000	44	64%
16	Lea County	$126,712,000	65	69%
Total		$4,294,402,000	2635	62%

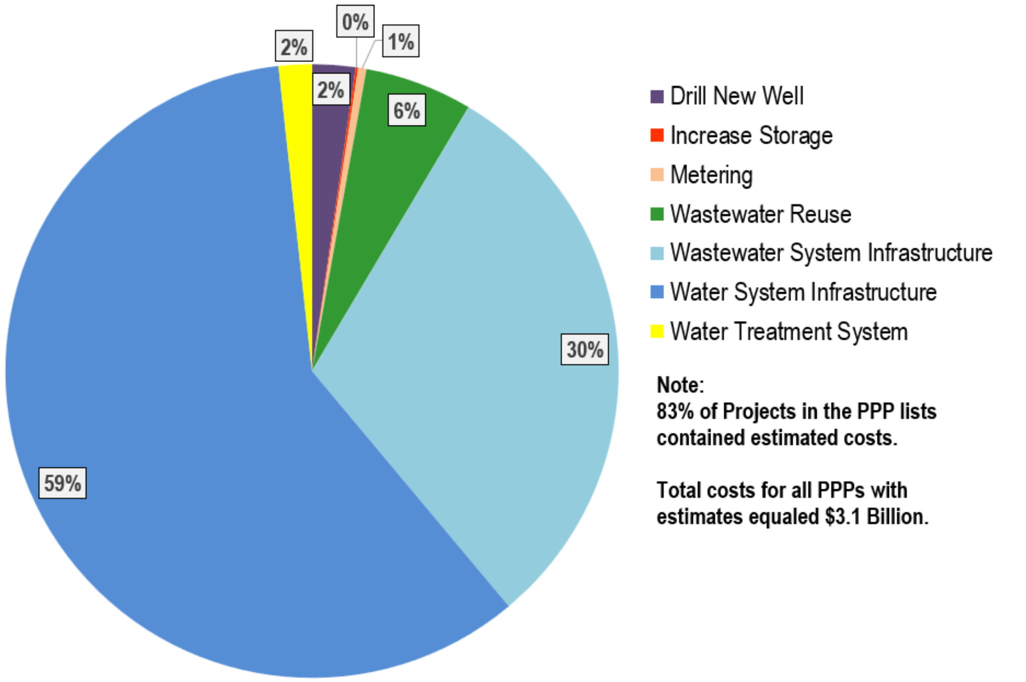


Figure 7-2. Estimated Costs for Public Water and Wastewater Infrastructure Projects.

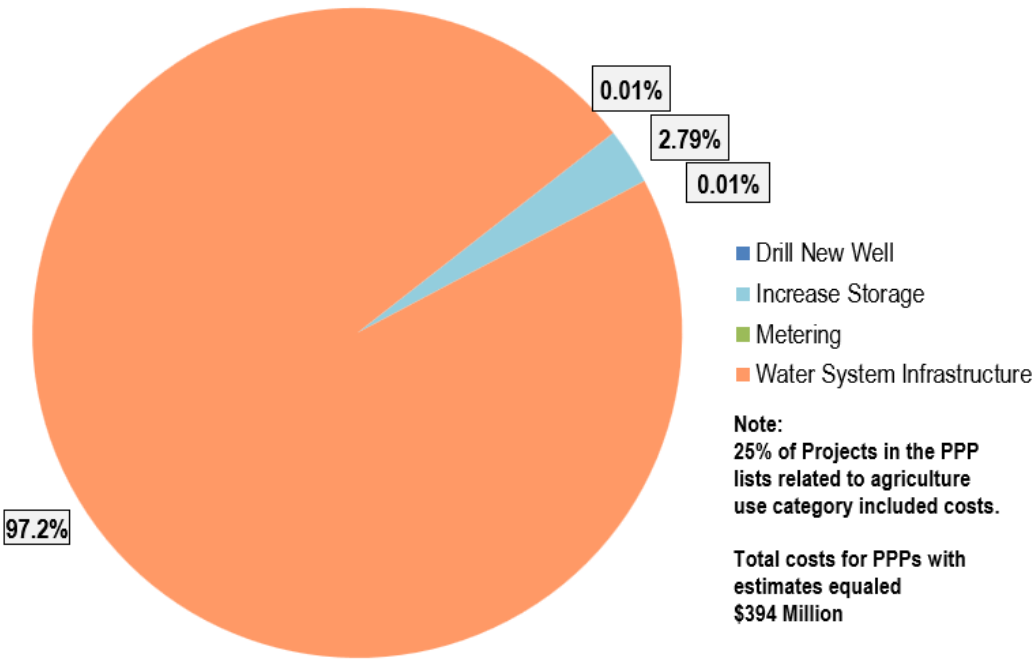


Figure 7-3. Estimated Costs for Agricultural Water Infrastructure Projects.

Table 7-6. Summary of Costs by Region for 20 Strategies.

Strategy		1	2	3	4	5	6	7
Region		Water System Infrastructure (M)	Wastewater System Infrastructure	Water System Infrastructure (A)	Stormwater System Infrastructure	Wastewater Reuse	Riparian Restoration	Watershed Restoration
1	Northeast New Mexico	107,109,000	--	--	--	68,450,000	2,310,000	--
2	San Juan Basin	209,496,000	112,561,000	1,514,000	2,256,000	--	1,444,000	3,367,000
3	Jemez y Sangre	149,481,000	57,630,000	2,090,000	5,733,000	--	720,000	855,000
4	Southwest New Mexico	77,347,000	6,978,000	14,264,000	5,106,000	14,061,000	390,000	17,680,000
5	Tularosa-Sacramento-Salt Basins	90,843,000	2,760,000	175,000,000	175,000	13,771,800	--	198,000
6	Northwest New Mexico	429,408,000	108,338,000	1,090,000	10,468,000	6,800,000	662,000	7,700,000
7	Taos	49,791,000	53,652,000	7,887,000	435,000	--	3,338,000	5,098,000
8	Mora-San Miguel-Guadalupe	73,985,000	19,016,000	31,305,000	15,397,000	3,807,000	17,843,000	41,346,000
9	Colfax	127,917,000	45,996,000	3,336,000	4,710,000	2,055,000	1,000,000	3,030,000
10	Lower Pecos Valley	113,778,000	65,375,000	--	37,854,000	31,190,000	1,750,000	1,100,000
11	Lower Rio Grande	198,313,000	244,812,000	300,000	54,869,000	1,400,000	--	--
12	Middle Rio Grande	110,199,000	137,667,000	6,870,000	205,235,000	3,750,000	19,150,000	58,807,000
13	Estancia Basin	1,595,000	980,000	135,000,000	3,362,000	1,090,000,570		900,000
14	Rio Chama	19,169,000	20,525,000	1,264,550	2,000,000		101,879,000	2,476,000
15	Socorro-Sierra	12,564,000	500,000	2,600,000	914,100	500,000	1,150,000	140,500
16	Lea County	29,507,000	40,215,000	--	11,945,000	26,587,000	--	--
Total		1,800,500,000	917,005,000	382,520,000	360,459,000	173,461,000	151,635,000	142,698,000

Table 7-6. Summary of Costs by Region for 20 Strategies (Continued).

Strategy		8	9	10	11	12	13	14
Region		Drill New Well	Dam Safety	Water Treatment System (M)	Water Conservation System (M)	Transfer Water Rights	Desalination	Metering
1	Northeast New Mexico	--	--	290,000	6,500,000	--	--	--
2	San Juan Basin	--	2,150,000	--	--	--	--	60,000
3	Jemez y Sangre	18,165,000	1,853,000	3,270,000	771,000	515,000	--	2,780,000
4	Southwest New Mexico	6,628,000	--	--	4,562,500	1,250,000	--	260,000
5	Tularosa-Sacramento-Salt Basins	2,190,000	--	1,468,707	36,400,000	--	8,500,000	--
6	Northwest New Mexico	16,738,000	5,000,000	281,000	--	--	--	142,000
7	Taos	420,000	--	--	--	1,450,000		943,000
8	Mora-San Miguel-Guadalupe	6,134,000	6,532,000	17,414,000	--	--	8,890,000	1,231,000
9	Colfax	2,490,000	21,121,000	350,000	--	4,050,000	--	--
10	Lower Pecos Valley	100,000	20,500,000	10,950,000	--	--	--	4,787,000
11	Lower Rio Grande	6,046,000	--	8,010,000	--	4,520,000	--	695,000
12	Middle Rio Grande	600,000	--	5,300,000	1,450,000	13,464,000	--	--
13	Estancia Basin	825,000	--	--	10,000	--	--	565,000
14	Rio Chama		1,759,000	5,903,000	--	500,000	--	
15	Socorro-Sierra	875,000	--	--	40,000	--	--	630,000
16	Lea County	8,370,000	--	--	33,000	750,000	--	1,300,000
Total		69,581,000	58,915,000	53,237,000	49,766,000	26,499,000	17,390,000	13,392,000

Table 7-6. Summary of Costs by Region for 20 Strategies (Continued).

Strategy		15	16	17	18	19	20
Region		Increase Storage (A)	Regional Water System	Regional Wastewater System	Dam Rehabilitation	Data Collection Hydrologic Studies	Water Planning
1	Northeast New Mexico	--	--	--	--	69,000	50,000
2	San Juan Basin	--	--	--	--	250,000	30,000
3	Jemez y Sangre	--	10,900,000	10,000,000	--	1,400,000	--
4	Southwest New Mexico	--	--	--	--	1,300,000	--
5	Tularosa-Sacramento-Salt Basins	--	--	--	--	564,000	65,000
6	Northwest New Mexico	--	--	--	--	175,000	--
7	Taos	--	--	--	--	290,000	110,000
8	Mora-San Miguel-Guadalupe	1,000,000	--	--	9,000,000	333,000	100,000
9	Colfax	--	--	--	--	478,000	--
10	Lower Pecos Valley	--	--	--	--	--	--
11	Lower Rio Grande	--	--	--	--	1,742,000	3,345,000
12	Middle Rio Grande	--	--	--	--	200,000	1,520,000
13	Estancia Basin	--	--	--	--	485,000	--
14	Rio Chama	10,000,000	--	--	--	660,000	1,020,000
15	Socorro/Sierra	--	--	--	--	--	150,000
16	Lea County	--	--	--	--	700,000	30,000
Total		11,000,000	10,900,000	10,000,000	9,000,000	8,646,000	6,420,000

Notes:
M = Municipal, A = Agriculture
Note that totals are rounded and may not match exact calculations.

7.3 DEVELOPING RECOMMENDATIONS TO THE STATE

While many water supply issues can be addressed by individuals or through collaboration among organizations, some aspects, such as policy changes or enforcement, need to be addressed by a state agency. As part of the planning process for updating the RWPs, the steering committees created recommendations to the state. The recommendations in each of the 16 regional water plans have been compiled for this report. A total of 116 recommendations ranged from requesting improved data collection and groundwater modeling to water planning to adjudication (Table 7-7).

Table 7-7. Recommendations to the State.

Category	Total Recommendations
Data collection/hydrologic studies	17
Water rights	17
Planning	16
Watershed restoration	10
Water quality protection	7
Acequias	5
Planning boundaries	5
Small drinking water systems	5
Wastewater reuse	5
Drought mitigation	4
Instream flow	4
Produced water	3
Conservation	2
Dam safety	2
Importation of water	2
Metering	2
Reservoir operations	2
Stormwater system infrastructure	2
Divert excess water for underground storage and recovery	1
Economic development planning	1
Increase precipitation	1
Infrastructure	1
Infrastructure-resilient to climate change	1
Political	1
Total	116

The recommendations involve the jurisdiction of many state and federal agencies, including ISC, OSE, New Mexico Environment Department, State Land Office, New Mexico Department of Game and Fish, NMBGMR, New Mexico State Forestry, New Mexico Department of Agriculture, United States Bureau of Reclamation, United States Army Corps of Engineers, United States Forest Service, and United States Bureau of Land Management.

The recommendations have been organized into categories and analyzed for similarities. A summary of these categories and common recommendations are presented in Appendix 2B. Most of the recommendations are for funding and others are for regulatory or policy changes, public outreach, development of new programs, or enforcement of existing regulations (Table 7-8).

Table 7-8. Summary of the Needs Related to Recommendations to the State.

Need	Total
Funding	59
Regulatory	24
Policy	16
Public Outreach/Stakeholder Involvement	11
Programmatic	3
Enforcement	3

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Appendix 2A

Water Supply and Demand Methodology

Contents

Acronyms and Abbreviations

ac-ft	acre-feet
ac-ft/yr	acre-feet per year
gpcd	gallons per capita per day
OSE	Office of the State Engineer
PDSI	Palmer Drought Severity Index
USGS	United States Geological Survey

2A.1. WATER SUPPLY METHODOLOGY

Using the common technical approach provided consistency in the methods used to define two types of water supply, the administrative supply (Section 2A.1.1) and drought-corrected supply (Section 2A.1.2). Details of the common technical approach for estimating the administrative supply and drought-corrected supply in the regional water plans completed in 2016 and 2017. The water supply for the San Juan Basin planning region was calculated differently, as described in Section 2A.1.3.

2A.1.1 Administrative Supply

The administrative water supply was developed as a tool to provide an overview of water supply that incorporates both physical and legal supplies to be used for broad state planning purposes. Administrative supply calculations are part of the common technical approach as presented in the Interstate Stream Commission (ISC) *Updated Regional Water Planning Handbook: Guidelines to Preparing Updates to New Mexico Regional Water Plans* (2013 Handbook). Administrative water supply is not intended to replace or negate the need for more detailed water budgets, models, and other analyses to inform specific projects or local planning decisions.

Considering the actual use as a measure of supply allows for a more accurate measure of available water because it discounts physical supplies that may be present in a region but are required by legal or policy restrictions to be conveyed downstream for use. For this *2018 New Mexico State Water Plan*, the amount of water supply which is considered available for use is the administrative supply.

The method used to estimate the administrative water supply is based on withdrawals of water as reported in the *New Mexico Water Use by Categories 2010* report (Longworth et al., 2013), which provide a measure of supply that considers both physical supply and legal restrictions (i.e., the water is physically available, and its use is in compliance with water rights policies). Because 2010 was a “normal” water supply year, based on a drought index, the water diverted in 2010 provides a reasonable approximation of the amount of water that is available for use by each region.

The Palmer Drought Severity Index (PDSI) was created by W.C. Palmer (1965) to measure variations in the moisture supply and is calculated using precipitation and temperature data as well as the available water content of the soil. Because it provides a standard measure that allows comparisons among different locations and months, this index is widely used to assess the weather during any time relative to historical conditions. The PDSI classifications for dry to wet periods are provided in Table 2A-1.

Table 2A-1. Palmer Drought Severity Index Classifications

PDSI Classification	Description
+ 4.00 or more	Extremely wet
+3.00 to +3.99	Very wet
+2.00 to +2.99	Moderately wet
+1.00 to +1.99	Slightly wet
+0.50 to +0.99	Incipient wet spell
+0.49 to –0.49	Near normal
–0.50 to –0.99	Incipient dry spell
–1.00 to –1.99	Mild drought
–2.00 to –2.99	Moderate drought
–3.00 to –3.99	Severe drought
–4.00 or less	Extreme drought

The PDSI is calculated for climate divisions throughout the United States. For the 8 climate divisions present in New Mexico, the PDSI classifications for 2010 were either near normal (5 climate divisions) or incipient wet spell (3 climate divisions). The locations of New Mexico Climate Divisions are shown in Figure 2A-1. The PDSI drought index consists of a ranking system derived from the assimilation of data—including rainfall, snowpack, streamflow, and other water supply indicators—for a given region. It also provides a useful indication of long-term relative variations in drought conditions, as PDSI records are available for more than 100 years.

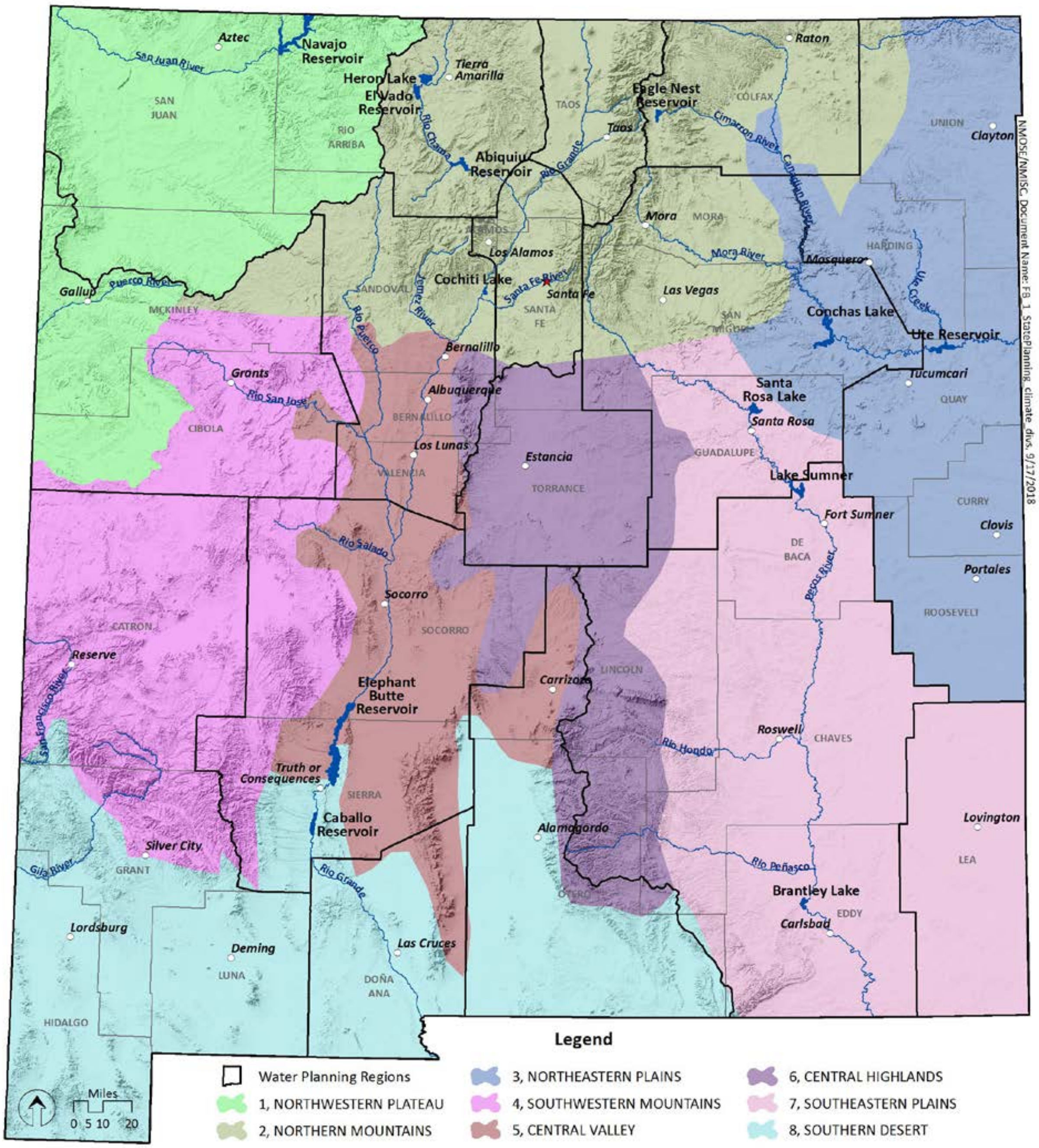

Figure 2A-1. Climate Divisions in New Mexico.

There are considerable limitations when using the PDSI, as it may not describe rainfall and runoff that varies between locations within a climate division and may also lag by several months in indicating emerging droughts. Also, the PDSI does not consider groundwater or reservoir storage, which can affect the availability of water supplies during drought conditions. However, even with its limitations, many states incorporate the PDSI into their drought monitoring systems.

For regions such as the Tularosa-Sacramento-Salt Basins planning region, where the aquifers are being depleted, the administrative water supply may not be sustainable in the future. In these cases, the future available supply was estimated as follows:

- Non-stream-connected groundwater basins with available Office of the State Engineer (OSE) administrative models were used to predict the water level declines in the year 2060, based on estimated groundwater diversions.
- These declines were compared to the available water column to assess the potential impact on future pumping.
- The predicted drawdown in 2060 from a model cell in a heavily stressed area was selected and compared to the available water column in existing wells to calculate the percentage of wells impacted by the drawdown.
- This percentage of impacted wells was assumed to reflect a percentage reduction in the available supply.

Another method to predict the future decline of the saturated thickness and thus available supply is to use existing wells with water level hydrographs and compare the predicted decline with the available water column in existing wells:

- Using the average rate of water level decline calculated from United States Geological Survey monitor wells within the non-stream-connected groundwater and assuming that this rate will continue, the water level decline to 2060 was predicted.
- The percentage of impacted wells was estimated by comparing the predicted drawdown to the available water column in existing wells, and the percentage of impacted wells was assumed to represent the reduction in supply by 2060.

By assuming that the percentage of impacted wells results in an equal impact on water supply, the estimated supply in 2060 is reduced proportionally in each of the Underground Water Basins.

Both of these approaches represent an approximation of the impact on existing wells by 2060. Factors that may affect the accuracy of these predictions include:

- The water columns may not represent the available supply because some existing wells could possibly be drilled deeper.
- The shallowest wells that are most impacted may not proportionally represent the distribution of pumping (the deeper wells most likely pump more than the shallow wells).
- New wells could be drilled in other parts of the aquifer; although doing so would require a water right permit.

2A.1.2 Drought-Corrected Supply

Given that the water use data for 2010 represent a 'near normal' to 'slightly wetter than normal' year, it cannot be assumed that this supply will be available in all years. It is important to also consider potential water supplies during drought periods. An estimate of supply during future drought conditions was developed for each region, by adjusting the 2010 withdrawal data (Longworth et al., 2013) based on physical supplies available during historical droughts.

There is no established method or single correct way of quantifying a drought supply given the complexity associated with varying levels of drought and constantly fluctuating water supplies. To provide an estimate of drought supplies for regional as well as statewide water planning, the state has developed and applied a consistent method for surface water/stream-connected aquifers and for groundwater supplies.

The method adopted for surface water/stream-connected aquifers is described below:

- The drought adjustment is applied only to the portion of the administrative water supply that derives from surface water, as it is assumed that groundwater supplies will be available during drought due to the relatively stable thicknesses of groundwater aquifers that are continuously recharged through their connection to streams. While individual wells may be depleted due to long-term drought, this drought adjustment does not include an evaluation of diminished groundwater supplies.
- The minimum annual yield for key stream gages on mainstem drainages was compared to the 2010 yield, and the gage with the lowest ratio of minimum annual yield to the 2010 yield was selected.
- The 2010 administrative surface water supply for the region was then multiplied by that lowest ratio to provide an estimate of the surface water supply adjusted for the maximum drought year of record.

Though the adjustment is based on the minimum year of streamflow recorded to date, it is possible that drought supplies could be even lower in the future. Additionally, water supplies downstream of reservoirs may be mitigated by reservoir releases in early drought phases, while longer-term droughts can have potentially greater consequences. This approach does not evaluate either the mitigating influences of reservoir storage during the early phases of a drought, when storage is available, or for the potential development of new groundwater supplies.

Also, in some parts of the state's larger planning regions, the surface water irrigators are far removed from developed groundwater sources. Thus, drought conditions may result in a much larger reduction than a normal year of water supplies in those areas. Nonetheless, the adjusted drought supply does provide a rough estimate of supply that might be available during a year of severe to extreme drought.

In non-stream-connected (or closed) basins, the administrative water supply was adjusted to consider the potential long-term drought impacts on groundwater. To predict the potential impact by 2060 of a 20-year drought, existing groundwater models were used, where available, to estimate the vulnerability of closed basins within a planning region during a prolonged drought.

The following method was adopted to estimate drought supplies for non-stream-connected aquifers:

- The drought adjustment was applied only to the portion of the administrative water supply that derives water from the mined aquifer.
- In basins for which the OSE has an administrative model, the simulation period was from 2010 to 2060 as described above, with no recharge from 2020 to 2040.
- For a conservative approximation, the drawdown predicted during the drought period was derived from a model cell in a heavily stressed area at the end of the simulation period (2060) to represent the water column that will be lost due to drought and pumping. For those basins where either no model is available, or where model results were not available, a drought correction of 12% was used, based on the average of the modeled drawdown from all the OSE administrative models for other regions of the state.
- This adjusted predicted drawdown is then compared to the median available water column in 2010 to determine the percentage of wells that are impacted by the 20-year drought and continued pumping.
- The reduction in supply due to drought is estimated by multiplying the percentage by the 2060 administrative supply.

2A.1.3 Supply Methodology for the San Juan Basin Adjustment

The 2013 Handbook (ISC, 2013) describes a common technical approach for analyzing the water supply in each water planning region but recognizes that other methods can be used to account for supply and demand. The 2016-2017 Regional Water Plan updates for 15 water planning regions in New Mexico present an analysis of the administrative water supply for the region using the technical approach described in the 2013 Handbook, as summarized here. However, the plan for the San Juan Basin planning region does not incorporate the technical approach described in the 2013 Handbook because it does not adequately address the following:

- The substantial reservoir storage capacity that was developed to allow the water in the San Juan River Basin to be used.
- Authorized full development of federal water supply projects (the Animas-La Plata Project, the Navajo-Gallup Water Supply Project, and the Navajo Indian Irrigation Project).
- Actual diversion practices and reservoir operations on the San Juan and Animas rivers.
- The water apportionments made to New Mexico by the Colorado River and Upper Colorado River Basin compacts.

Because of these circumstances, the long-term amount of water from the San Juan River stream system that is available for use in New Mexico during normal (non-drought) years far exceeds the administrative water supply, as well as the severe drought-adjusted administrative water supply that would be calculated when using the technical approach described in the 2013 Handbook. The water supply calculation used for the San Juan Basin planning region is described below.

2A.1.3.1 San Juan Basin Normal Water Year Supply

The terms of the 1922 Colorado River Compact include several provisions important to the San Juan Basin planning region:

- The Upper Colorado River Basin was apportioned the consumptive use of 7.5 million acre-feet per year (ac-ft/yr) from the Colorado River system.
- The states of the Upper Division (New Mexico, Colorado, Utah, and Wyoming) may not cause the flow of the Colorado River at Lee Ferry to be depleted below an aggregate of 75,000,000 ac-ft in any period of 10 consecutive years.

Under the terms of the 1948 Upper Colorado River Basin Compact, New Mexico was apportioned 11.25% of the consumptive use available to the Upper Basin under the Colorado River Compact and remaining after deduction of 50,000 ac-ft apportioned to Arizona. The Secretary of the Interior determined in the report *2007 Hydrologic Determination* (USBOR, 2007) that at least 5.76 million ac-ft/yr, on average, of consumptive use, excluding reservoir evaporation from Lake Powell, Flaming Gorge Reservoir, and the Aspinall Unit reservoirs of the Colorado River Storage Project is available to the Upper Basin.

After subtraction of the 50,000 ac-ft that was apportioned to Arizona, New Mexico's share of the Upper Basin yield is at least 642,380 ac-ft/yr of consumptive use, on average, for water development within the state. The amount of diverted water may substantially exceed the amount of water consumptively used. Also, return flows from uses of water diverted from the San Juan or Animas rivers are generally available for diversion to meet water demands for downstream uses.

2A.1.3.2 San Juan Basin Drought Supply

The variability in surface water supply over a multi-year period for a region with a large water supply reservoir is a good indicator of how vulnerable a planning region would be under conditions of drought. There is no established method or single correct way to quantify a drought supply given the complexity associated with varying levels of drought and water supplies that constantly fluctuate.

As a result, the state has adopted the following method to provide an estimate of drought supplies for the San Juan Basin planning region:

- The drought adjustment is applied to the 2060 high demand scenario.
- The United States Geological Survey stream gage on the Animas River (Animas River near Cedar Hill) was selected as a representative gage for the region.
- The ratio of the minimum value derived from the three-year moving average of the mean annual flow to the median value of the mean annual flow for the Animas River near Cedar Hill stream gage was used to provide an estimate of the surface water supply, adjusted for multi-year drought.

For the Animas River near Cedar Hill gage, the minimum value of the three-year moving average is 406,580 ac-ft. The median value of annual flow at the gage is 624,711 ac-ft. The ratio of these two values is 65.1% (406,580/624,711). Based on the region's high scenario demand in year 2060 of 1,122,500 ac-ft, the drought-adjusted water supply is 730,750 ac-ft. This is a rough estimate of what may be available during an extended drought.

2A.2. WATER DEMAND METHODOLOGY

2A.2.1 Projection Methods

Projections of future demand in 9 categories of water use are based both on demographic and economic trends and on population projections. Consistent methods and assumptions for each category of water use were applied across all planning regions.

As discussed in the 2013 Handbook (ISC, 2013), many methods can be used to account for supply and demand; however, some tools used to implement these analyses are available only for some segments of New Mexico, and resources to develop them for all regions are not currently available. Therefore, the state developed a simple method that was used consistently across all regions (except for the San Juan Basin planning region) to assess and project demands for planning purposes.

The use of this consistent method allowed for the efficient development of a statewide overview of the balance between supply and demand in both normal and drought conditions. This method allows the state to move forward with planning and funding water projects and programs that will address pressing water issues both for the planning regions and for the state.

These projections began with 2010 data and were developed in 10-year increments (2020, 2030, 2040, 2050, and 2060). Projections were developed for withdrawals in each of the nine categories included in the *New Mexico Water Use by Categories 2010* report (Longworth et al., 2013).

To assist in bracketing the uncertainty of the projections, low and high water demand estimates were developed for each water use category in which growth is anticipated. These estimates were based on demographic and economic trends as well as population projections, unless specific adjustments were applied based on local conditions, as detailed in the 2016-2017 RWP updates. The projected growth in population and economic trends affects water demand in eight of the nine water use categories; the reservoir evaporation water use category is not driven by these factors.

The 2010 withdrawals were used as a base from which water demand was projected forward, except in the San Juan Basin planning region, as noted previously.

2A.2.2 Projection Methods by Water Use Categories

The assumptions and methods used to develop the demand projections for each water use category follow. Not all categories are applicable to every planning region. Issues specific to various planning regions are detailed in each of the 2016-2017 RWP updates.

Public water supply includes community water systems that rely on surface water and groundwater diversions other than from domestic wells permitted under 72-12-1.1 NMSA 1978 and that consist of common collection, treatment, storage, and distribution facilities operated for the delivery of water to multiple service connections. This definition includes municipalities (which may serve residential, commercial, and industrial water users), mutual domestic water user associations, prisons, residential and mixed-use subdivisions, and mobile home parks.

For regions with anticipated population increases, the increase in projected population (high and low) was multiplied by the per capita use from the *New Mexico Water Use by Categories 2010* report (Longworth et al., 2013) (reduced for conservation as specified below), multiplied by the portion of the population that was publicly supplied in 2010 (calculated from Longworth et al. [2013]); the resulting value was then added to the 2010 public water supply withdrawal amount. Current surface water withdrawals were not allowed to increase above the 2010 withdrawal amount unless there is a new source of available supply (i.e., water project or settlement). Both high and low projections incorporated conservation for counties (see specific conservation assumptions listed below).

For planning purposes, in counties where a decline in population is anticipated (in either the high or low scenario, or both), it was assumed as a conservative approach that the public water supply would remain constant at 2010 withdrawal levels based on the 2010 administrative water supply (the water is physically available for withdrawal, and its use is in compliance with water rights policies). Likewise, in regions where the population growth is initially positive but later shows a decline, the water demand projection was kept at the higher rate for the remainder of the planning period.

The *domestic (self-supplied)* water use category includes self-supplied residences with well permits issued by the OSE under 72-12-1.1 NMSA 1978 (Longworth et al., 2013). Such residences may be single-family or multi-family dwellings. High and low projections were calculated as the 2010 domestic withdrawal amount plus a value determined by multiplying the projected change in population (high and low) times the domestic self-supplied per capita use from the *New Mexico Water Use by Categories 2010* report (Longworth et al., 2013) times the calculated proportion of the population that was self-supplied in 2010 (calculated from Longworth et al., 2013). In counties where the high and/or low projected growth rate is negative, the projection was set equal to the 2010 domestic withdrawal amount. This allows for the continuing use of existing domestic wells, which is anticipated, even when there are population declines in a county. In regions where the population growth is initially positive but later shows a decline, the water demand projection was kept at the higher level for the remainder of the planning period, based on the assumption that domestic wells will continue to be used, even if there are later population declines.

The *irrigated agriculture* water use category includes all withdrawals of water for the irrigation of crops grown on farms, ranches, and wildlife refuges (Longworth et al., 2013). To understand trends in the agricultural water use category, interviews were held with farmers, farm agency employees, and others with extensive knowledge of agriculture practices and trends in each planning region and in multiple counties in the larger regions. Additionally, the New Mexico agriculture census data for 2007 and 2012 were reviewed and provided helpful agricultural data such as principal crops, irrigated acreage, farm size, farm subsidies, and age of farmers (USDA NASS, 2014). Comparison of the two data sets shows a downward trend in the agricultural water use category across New Mexico. This decline was likely related at least in part to the lack of precipitation in 2012: in most of New Mexico, 2007 was a near-normal precipitation year (ranging from mild drought to incipient wet spell across the state), while in 2012 the PDSI for all New Mexico climate divisions indicated extreme to severe drought conditions. Based on the interviews, economic factors are also thought to be a cause of the decline.

In much of the state, recent drought and recession are thought to be driving a decline in agricultural production. However, that does not necessarily indicate that there is less demand for water. In areas where irrigation is supplied by surface water, there are frequent supply limitations, with many ditches having no or limited supply later in the season. This results in large fluctuations in agricultural water use and productivity from year to year. Though long-term drought may occur at some point, it is also likely that drought years will be interspersed with wetter years, and renewed agricultural activity is likely as a result. With infrastructure and water rights in place, there is a demand for water if it becomes available.

In regions that use surface water for agriculture withdrawals, the 2010 administrative water supply used as the starting point for the projections reflects a near-normal water year for the region. For 2020 through 2060 projections, therefore, it was generally assumed that the surface water demand is equal to the 2010 administrative water supply for both the high and low demand scenarios. Even if some farmers cease operations or plant less acreage, the water is expected to be used elsewhere due to surface water shortages. Conversely, if increased agricultural activity is anticipated, water demand in this water use category was still projected to stay at 2010 administrative water supply levels unless there is a new source of available supply (i.e., water project or settlement).

In areas where 10% or more of groundwater withdrawals are for agriculture and there are projected declines in agricultural acreage, the low projection assumes that there will be a reduced demand in this water use category. The amount of projected decline is based on interviews with individuals knowledgeable about the agricultural economy in each county, as detailed in the 2016-2017 RWP updates. Even in areas where the data indicate a decline in the agricultural economy, the high projection assumes that overall water demand will remain at the 2010 administrative water supply levels, since water rights have economic value and will continue to be used.

The ***livestock*** water use category includes water used to raise livestock, maintain self-supplied livestock facilities, and support on-farm processing of poultry and dairy products (Longworth et al., 2013). High and low projections for the percentage growth or declines in the livestock water use category were developed based on interviews with ranchers, farm agency employees, and others with extensive knowledge of livestock trends in each county. The growth or decline rates were then multiplied by the 2010 water use values to calculate future water demand.

The *commercial (self-supplied)* water use category includes self-supplied businesses (e.g., motels, restaurants, recreational resorts, and campgrounds) and public and private institutions (e.g., public and private schools and hospitals) involved in the trade of goods or provision of services (Longworth et al., 2013). This water use category pertains only to commercial enterprises that supply their own water; commercial businesses that receive water through a public water system are not included. To develop the commercial self-supplied projections, it was assumed that commercial development is proportional to other growth, and the high and low projections were calculated as the 2010 commercial water use multiplied by projected high and low population growth rates. In regions where the growth rate is negative, both high and low projections were assumed to stay at the 2010 administrative supply water level, based on water rights having economic value. In regions where population growth is initially positive but later shows a decline, the water demand projections will remain at higher levels for the remainder of the planning period, again based on the administrative water supply and the value of water rights. This method was modified in some regions to consider specific information regarding plans for large commercial development or increased use by existing commercial water users.

The *industrial (self-supplied)* water use category includes self-supplied water used by enterprises that process raw materials or manufacture durable or nondurable goods and water used for the construction of highways, subdivisions, and other construction projects (Longworth et al., 2013). To collect information on factors affecting potential future water demand, economists conducted interviews with industrial users and used information from the New Mexico Department of Workforce Solutions to determine if growth is expected in this water use category. Based on these interviews and information, high and low scenarios were developed to reflect the ranges of possible growth. If water use in this water use category is low and limited additional demand is expected, then both high and low projections are the same.

The *mining* water use category includes self-supplied enterprises that extract minerals occurring naturally in the earth's crust, including solids (e.g., potash, coal, and smelting ores), liquids (e.g., crude petroleum), and gases (e.g., natural gas). Anticipated changes in water use in this water use category were based on interviews with individuals involved in or knowledgeable about the mining water use category. If water use in this water use category is low and limited additional demand is expected, then both high and low projections are the same.

The *power* water use category includes all self-supplied power generating facilities and water used in conjunction with coal-mining operations that are directly associated with a power generating facility that owns and/or operates the coal mines. Anticipated changes in water use in this water use category were based on interviews with individuals involved in or knowledgeable about the power water use category. If water use in this category is low and limited additional demand is expected, then both the high and low projections are the same.

Reservoir evaporation includes estimates of open-water evaporation from man-made reservoirs with a storage capacity of approximately 5,000 ac-ft or more. The amount of reservoir evaporation is dependent on the surface area of the reservoir as well as the rate of evaporation. Evaporation rates are partially dependent on temperature and humidity; that is, when it is hotter and drier, evaporation rates increase. Surface areas of reservoirs are variable, and during extreme drought years, the low surface areas contribute to lower total evaporation, even though the rate of evaporation may be high.

The projections of reservoir evaporation for each region were based on evaporation rates reported in the *Upper Rio Grande Impact Assessment* (USBOR, 2013), which evaluated potential climate change impacts in New Mexico. This report predicted considerable uncertainty, but some increase in evaporation rates and lower evaporation totals overall due to predicted greater drought frequency and resultant lower reservoir surface areas. Although it is possible that total evaporation will be lower in drought years, since the projections are to be compared to 2010 use, assuming lower reservoir evaporation would give a false impression of excess water. Thus, the low projection assumes 2010 evaporation amounts. For the high projection, the same surface areas as 2010 were assumed, but higher evaporation rates, derived from the *Upper Rio Grande Impact Assessment* (USBOR, 2013), were used to reflect potentially warmer temperatures. The high scenario projected using this approach represents a year in which there is a normal amount of water in storage, but the evaporation rates have increased due to increasing temperatures.

The fluctuations in reservoir evaporation are expected to be much greater than the high/low range projected using this method. To evaluate the balance between supply and demand, the projections are being compared to the administrative water supply, including reservoir evaporation. It is important to not show an unrealistic scenario of excess available water. Therefore, the full range starting with potentially very low reservoir surface areas was not included in the projections.

2A.2.3 Water Conservation Assumptions in the Water Demand Projections

To develop demand projections for the regions, some simplifying assumptions regarding conservation have been made. These assumptions were made only for developing an overview of the future supply-demand balance in the regions and are not intended to guide policy regarding conservation for individual water users. The approach to considering conservation in each category of water use for developing water demand projections is discussed below.

Public water supply. Public water suppliers that have large per capita usage have a greater potential for conservation than those that are already using water more efficiently. Through a cooperative effort with seven public water suppliers, the OSE developed a gallons per capita per day (gpcd) calculator to be used statewide, thereby standardizing the methods for calculating populations, defining categories of use, and analyzing use within these categories. The gpcd calculator was used to arrive at the per capita uses for public water systems in each region and were provided to assist the regional steering committees in considering specific conservation measures.

The system-wide per capita usage for each water supplier includes uses such as golf courses, parks, and commercial enterprises that are supplied by the system. Hence there can be large variability among the systems. For purposes of developing projections, a county-wide per capita rate was calculated as the total public supply use in the county divided by the total county population (or portion of the county within a region), excluding those served by domestic wells. For future projections, a consistent method was used statewide which assumes that conservation would reduce future per capita use in each county by the following amounts:

- For current average per capita use greater than 300 gpcd
  - Assume a reduction in future per capita use to 180 gpcd.
- For current average per capita use between 200 and 300 gpcd
  - Assume a reduction in future per capita use to 150 gpcd.
- For current average per capita use between 130 and 200 gpcd
  - Assume a reduction in future per capita use to 130 gpcd.
- For current average per capita use less than 130 gpcd
  - No reduction in future per capita use is assumed.

Self-supplied domestic. Homeowners with private wells can achieve water savings through household conservation measures. These wells may not be metered, and current water use estimates were developed based on a relatively low per capita use assumption (Longworth et al., 2013). Therefore, no additional conservation savings were assumed in developing the water demand projections. For purposes of developing projections, a county-wide per capita rate was calculated as the total self-supplied domestic use in the county divided by the total county population (or portion of the county within the region), excluding those served by a public water system.

Irrigated agriculture. As the largest water use in the state, conservation in this water use category may be the most beneficial. However, when considering the potential for improved efficiency in agricultural irrigation systems, it is important to consider how potential conservation measures may affect the region's water supply.

Withdrawals in both surface and groundwater irrigation systems include both consumptive and non-consumptive uses and incidental losses:

- Consumptive use occurs when water is permanently removed from the system due to crop evapotranspiration (i.e., evaporation and transpiration). Evapotranspiration is determined by factors that include crop and soil type, climate and growing season, on-farm management, and irrigation practices.
- Non-consumptive use occurs when water is temporarily removed from the stream system for conveyance requirements and is returned to the surface or groundwater system from which it was withdrawn.
- Incidental losses from irrigation are irrecoverable losses due to seepage and evapotranspiration during conveyance that are not directly attributable to crop consumptive use.
  - Seepage losses occur when water leaks through the conveyance channel or below the root zone after application to the field and is either lost to the atmosphere or remains bound in the soil column.
  - Evapotranspiration occurs because of (1) evaporation during water conveyance in canals or with some irrigation methods (e.g., flood, spray irrigation) and (2) transpiration by ditch-side vegetation.

Some agricultural water use efficiency improvements (commonly referred to as agricultural water conservation) reduce the amount of water diverted but may not reduce depletions or may even have the effect of increasing consumptive use per acre on farms (Brinegar and Ward, 2009; Ward and Pulido-Velazquez, 2008). These efforts can result in economic benefits, such as increased crop yield, but may have the adverse effect of reducing return flows and, therefore, the timing and availability of downstream water supply. For example, methods such as canal lining or piping may result in the reduction of seepage losses associated with conveyance, but that seepage will no longer provide return flow to other users. Other techniques, such as drip irrigation and center pivots, may reduce the amount of water diverted, but if the water saved from such reductions is applied to on-farm crop demands, the timing and availability of water supplies for downstream uses will be reduced.

Due to the complexities in agricultural irrigation efficiency, no quantitative estimates of savings are included in the projections. However, the regions were encouraged to explore strategies for agricultural conservation, especially those that result in consumptive use savings through changes in crop type or fallowing of land while concentrating limited supplies for greater economic value on smaller parcels.

Self-supplied commercial, industrial, livestock, mining, and power. Conservation programs can be applicable to these categories, but since uses are expected to be relatively low in the commercial, livestock, and power categories within the region, no additional conservation savings are assumed in the water demand projections in the 2016-2017 RWP updates. As a more significant user, the mining water use category is encouraged to explore conservation opportunities; however, no quantitative estimates of potential conservation savings are available currently.

Reservoir evaporation. No water conservation assumptions were applied to the reservoir evaporation water use category.

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Appendix 2B

Recommendations to the State from Regional Water Planning Steering Committees

Contents

Acronyms and Abbreviations

RWP	Regional Water Plan
NMED	New Mexico Environment Department
OSE	Office of the State Engineer

Introduction

The following recommendations were developed by the regional planning steering committees and included in the 2016-2017 Regional Water Plan updates (RWPs).

This compilation from the steering committees provides insight into the concerns of various regions. Recommendations from all regions are categorized here, and are numbered to enhance discussion, not to rank importance. Recommendations were meant to be collected in an open manner to enhance regional participation and obtain a variety of ideas. Some of the recommendations may contradict each other, some may be considered controversial, and some are recommendations of actions which are already being implemented by local, state, tribal, and federal agencies.

These recommendations helped to inform the *2018 New Mexico State Water Plan Part 1: Policy Report* and illustrated the need to clarify the existing institutional infrastructure for addressing many of the recommendations.

Recommendations by Subject

Planning

1. Seek funding for ongoing regional water planning and RWP implementation.
2. Provide $1 million per water planning region in state funds for implementation.
3. Set up inter-regional cooperative working groups to address common interests and issues and to identify opportunities for collaboration.
4. Present RWP program and project needs to the legislative interim water and agriculture committee.
5. Consider including tribal water use in regional water planning*.
6. Integration of water supply and wastewater treatment planning for infrastructure.
7. Support for water conservation, source water protection, drought mitigation, and RWP implementation.
8. Support drinking water system collaboration efforts and regionalization projects.
9. Define goals of sustainable groundwater use for each groundwater basin that is being mined.
10. Focus plans on long-term sustainability and resilience of water resources.

*Tribal participation was solicited and encouraged by the state during the regional water planning processes. It was the prerogative of tribes whether to provide water use data to the state. The process used in estimation of water use for the Office of the State Engineer (OSE) Technical Report 54, *New Mexico Water Use by Categories 2010,* reasonably captures both tribal and non-tribal water use.

Planning Boundaries

1. Evaluate geographical boundaries of existing water planning regions to identify areas where it may be appropriate to adjust boundaries based on local considerations (e.g., a water system or community that is separated into two planning regions, or two watersheds).
2. Consider renaming Region 6, since Northwest New Mexico planning region does not accurately reflect the geographical boundaries of the region. This region does not include San Juan County, which covers the northwestern corner of the state.

Data Collection/Hydrologic Studies

1. Developing and maintain a comprehensive statewide water budget.
2. Exploring alternative water sources to identify new supplies through aquifer mapping and exploratory drilling.
3. Provide funding to continue data collection, aquifer mapping, and water quality monitoring.
4. Meter pumping for improved water budget/groundwater modeling analysis.
5. Improve groundwater modeling.
6. Enforcing regulations for well drillers to report water level data to the OSE.
7. Improve understanding of impacts from climate change.
8. Improve reservoir loss accounting.
9. Develop a database of geohydrology reports.

Water Rights

1. Discussion of water rights on topics such as (1) forfeiture of water rights, (2) reductions in water rights diversions within critical management areas, and (3) the ability of farmers to expand their irrigated acreage to use water that is conserved. Some regions have significant "paper rights" that have never been put to beneficial use, which presents challenges for planning and managing the water resources.
2. Revise the 40-year water plan provision (Water Development Plan) to require longer term water planning.
3. Change subdivision regulations (developed by county governments) to support community water supply and return flows.
4. Adjudicate water rights.
5. Support policy to protect water rights from loss for non-use when placed in a conservation plan or an acequia water bank.
6. Define agricultural water use and what constitutes waste of agricultural water.
7. Enhanced Water Right Administration: Increased enforcement of existing policies, which will require increased staffing and overall capacity at the OSE.
8. When considering inter-basin transfer applications, the OSE should be mindful of Senate Joint JM 17 (2008) considerations as well as local public welfare statements, criteria, and priorities.
9. Educate title companies statewide on the need to file a change-of-ownership form for real estate that includes a well.
10. Work with the Estancia Basin Water Planning Council on the criteria for deepening wells in the Estancia Basin.
11. Allow flexibility for water banking, leasing, and temporary transfers of water.
12. Meter acequias and mutual domestic water associations so that they may receive return flow credits.
13. Protect water rights by ensuring proper use of the Water Use Leasing Act (72-6-1 to 72-6-7 NMSA 1978) and the emergency / temporary water permit process (72-5-25 NMSA 1978).
14. Support conjunctive use strategies.

Small Drinking Water Systems

1. Support for small drinking water systems through capacity, administration, rate analysis, and asset management.

Watershed Restoration

1. Provide resources and dedicated funding for watershed-scale watershed management and restoration and playa lake (also known as dry lakes or alkali flats) conservation projects.
2. Support education for best management practices to protect watersheds, including catastrophic fire prevention and mitigation and livestock management.
3. Develop programs and policies that encourage locally produced small-diameter timber use and support landscape-level forest restoration.
4. Encouragement of best management practices for grazing.

Water Quality Protection

1. Consider modifying New Mexico Environment Department (NMED) liquid waste disposal regulations to include a provision for enforcement to protect water quality.
2. Develop policies that provide for water quality protection in headwater watersheds, rivers, and creeks.
3. Increase the budget available to the Monitoring, Assessment, and Standards section of the Surface Water Quality Bureau to allow for more staff to conduct more surface water monitoring around the state.
4. Increase funding for the River Stewardship Program. This funding is available on a competitive grant basis from the Surface Water Quality Bureau of NMED for surface water restoration projects. This is on-the-ground funding with no match required.
5. Develop policies for oil and gas development for protection of water quality.
6. Monitor the proposed expansion of the scope of the Clean Water Act and the potential impact to water management and supplies.

Acequias

1. Support for acequias through capacity building, administration, financial, audit, and governance supports.
2. Address anti-donation clauses related to funding for public/private projects (to allow for shared ditch lining) where ditches serve both agricultural associations and public water systems.

All Other Recommendations

1. Statewide economic development initiatives that encourage low-water-use industries and green infrastructure and low-impact development policies.
2. Support the creation of an agricultural water conservation initiative, which would pay producers to reduce their irrigation demands by funding the implementation of agricultural water conservation strategies.
3. Review dam safety regulations for both unnecessary requirements and areas where additional safety is needed and provide funding and resources to address safety issues.
4. Recommend changing the State Constitution to allow for sale of excess water for recharge.
5. Work with the other states to revisit the interstate compacts, to add drought provisions.
6. Provide resources and follow-up to link and implement state and local drought planning, including Emergency Preparedness, long-term planning, drought contingency, and alternative water resource; ensure that all water providers have a drought contingency plan.
7. Exploration of changing subdivision regulations to support community water supply.
8. Develop a state policy for importation and transfers of water; the state should consider statutory and administrative measures to expedite transfers, protect water rights, and monitor compliance.
9. Develop and implement a statewide policy and program for weather modification initiatives to increase precipitation as supported by scientific study and previous projects implemented in New Mexico.
10. Support capacity for Councils of Government to address large-scale issues (infrastructure)
11. Clarify the definition of beneficial use and the use of water rights for instream flow purposes. Exploration of instream flow opportunities (legal protection for beneficial use and compatibility with acequias).
12. Require metering and reporting on all wells to improve estimates of actual water use.
13. Support state and local control and management of water resources, in response to attempts to federalize water management.
14. Evaluate mechanisms that affect the market for produced water; provide incentives for use of produced water.

15. Coordinate with federal agencies to explore the possibility of planning dam release schedules for downstream users to minimize negative impacts and maximize benefits to local acequias.
16. Reduce state water losses: evaporative losses from reservoirs and conveyance channels are significant and should be addressed.
17. Establish flood control districts where none exist to provide flood control projects with revenue from contracts; levy ad valorem taxes, or newly issued bonds to help prepare communities for high-intensity storm events.
18. Develop water disaster recovery programs, including flood preparation and mitigation.
19. Include wastewater planning and reuse as part of future regional water planning efforts.
20. Support policies that promote water reuse and efforts to advance treatment technologies (reducing costs).
21. Modify NMED Regulations: current water quality standards are too stringent, making reuse difficult and expensive for use in injection for underground storage, discharge to the Pecos River, or for direct reuse.

Appendix 2C
Addressing the Supply-Demand Gap

Contents

Acronyms and Abbreviations

ac-ft/yr	acre-feet per year
AWSA	Arizona Water Settlement Act
CAP	Central Arizona Project
gpcd	gallons per capita per day
ISC	New Mexico Interstate Stream Commission
NMED	New Mexico Environment Department
OCD	Oil Conservation Division, New Mexico Energy, Minerals, and Natural Resources Department
OSE	Office of the State Engineer
PPP	projects, programs, and policies (as suggested by New Mexico water planning steering committees)
RWP	Regional Water Plan
TDS	total dissolved solids
WRRI	Water Resources Research Institute, New Mexico

2C.1 PLANNING FOR SUPPLY-DEMAND GAPS IN NEW MEXICO

During the 2016-2017 regional water planning process, each of the 16 water planning regions in New Mexico had a representative steering committee. Each steering committee was comprised of local and regional stakeholders and organizations, such as regional Councils of Government, water providers, agricultural districts and acequias, elected officials, active water planning councils, local, state, federal, and non-government technical advisors, and other water interests. Steering committees represent the different water user groups identified in the New Mexico Interstate Stream Commission (ISC) *Updated Regional Water Planning Handbook: Guidelines to Preparing Updates to New Mexico Regional Water Plans* (2013 Handbook).

The regional steering committees provided feedback on the technical information and developed lists of PPPs (projects, programs, and policies) and recommendations to the state for efforts such as improving water management in New Mexico, assessing the statewide infrastructure needs, and opportunities for collaboration. Over 2,600 PPPs were compiled and summarized according goals (such as increase supply, reduce demand, protect supply, improve efficiency, or prepare for drought). The submitted key issues, PPPs, and recommendations to the state helped inform the policy topics presented in the *2018 New Mexico State Water Plan Part I: Policies.*

A summary of the PPPs recommended by the steering committees for closing the supply and demand gap is provided here, first focused on PPPs that reduce demand and then those that increase the supply, followed by other suggested supply-demand gap management strategies.

2C.2 REDUCING DEMAND THROUGH WATER CONSERVATION BY WATER USE CATEGORY

Water conservation is often a cost-effective and easily implementable measure that a region may use to help balance supplies with demands. The state of New Mexico is committed to water conservation programs that encourage wise use of limited water resources. The Water Use and Conservation Bureau of the Office of the State Engineer (OSE) developed the *New Mexico Water Conservation Planning Guide for Public Water Suppliers.* When evaluating water rights transfers or *Water Development Plans* (also known as 40-year Water Plans) that hold water rights for future use, the OSE considers whether adequate conservation measures are in place.

To develop demand projections for the region, some simplifying assumptions regarding conservation were made for the 2016-2017 Regional Water Plan (RWP) updates. These assumptions were made only for developing an overview of the future supply-demand balance in the region and are not intended to guide policy regarding conservation for individual water users. The approach to considering conservation in each category of water use for developing water demand projections is discussed below.

2C.2.1 Public Water Use Category

Public water suppliers that have large per capita usage have a greater potential for conservation than those that are already using water more efficiently. Longworth et al. (2013) reports the gallons per capita per day (gpcd) for public water systems and the average gpcd by county, presented in Figure 2C-1.

As explained in Appendix 2A, water conservation was already factored into calculations of future demand, but not for the existing population. Thus, only the future additional population added to a region was assumed to implement conservation measures. This is a reasonable assumption because newer homes tend to have more water-saving fixtures, such as low-flow toilets and faucets. Additional savings can be achieved with existing populations, and many communities are pursuing conservation efforts that range from education to tiered rate structures based on water use.

Figure 2C-2 shows the total potential savings by county within each region if per capita demand is reduced to 130 gpcd (where the average was greater than 130 gpcd). A reduction to 130 gpcd may or may not be realistic if a community has government buildings, educational institutions, or industries that contribute to the per capita demand. However, the City of Santa Fe—which is the state capital with government offices and many employees who commute from outside the city limits and has a large tourist industry—has reduced per capita demand from 168 gpcd in 1995 to 90 gpcd in 2015 (City of Santa Fe, 2016). If the demand in the entire state were reduced to 130 gpcd, the total potential savings for the 1.7 million people served by public water systems statewide is 66,000 acre-feet per year (ac-ft/yr), as shown in Table 2C-1.

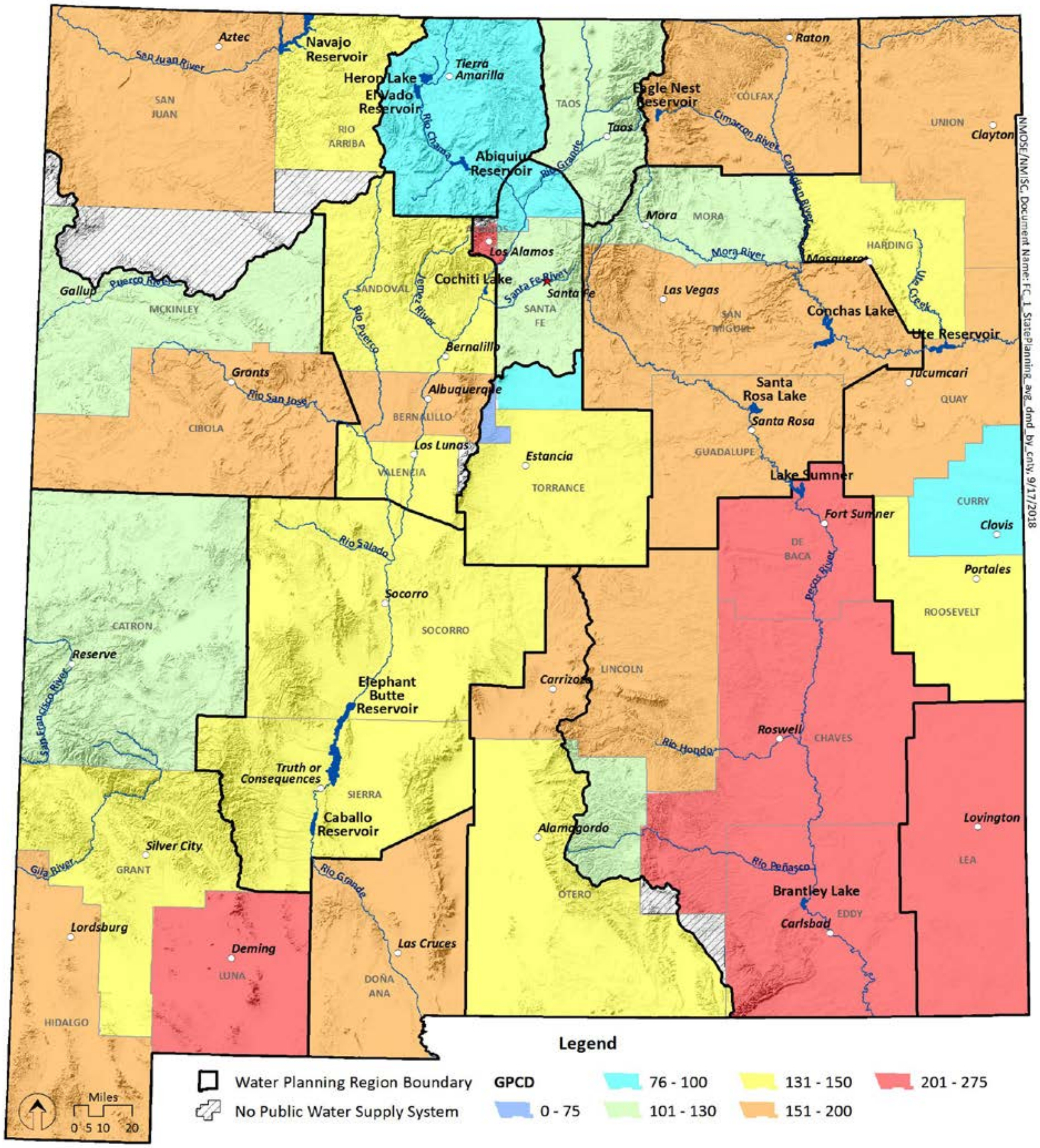

Figure 2C-1. Average Per Capita Demand by County and Water Planning Region Serving Public Water Systems.

Table 2C-1. Potential Water Savings through Conservation Efforts by Public Water Systems.

Region Name	Reg No	County Portion within Region	Average Per Capita per Day on Public Water Systems (gallons)	Population in 2010 served by Public Water Systems	Potential Water Savings Per Capita Reduced to 130 GPCD (ac-ft per year)
Northeast New Mexico	1	Curry	100	6,630	0
		Harding	148	418	8
		Quay	183	8,304	493
		Roosevelt	142	18,276	246
		Union	192	2,628	183
San Juan Basin	2	McKinley	0	0	0
		Rio Arriba	148	4,050	82
		Sandoval	0	0	0
		San Juan	162	108,239	3,880
Jemez y Sangre	3	Rio Arriba	87	14,334	0
		Sandoval	0	0	0
		Santa Fe	102	108,238	0
		Los Alamos	202	17,950	1,448
Southwest New Mexico	4	Catron	110	1667	0
		Luna	209	17,344	1,535
		Grant	141	16,870	208
		Hidalgo	164	3,431	131
Tularosa-Sacramento-Salt Basins	5	Chaves	0	0	0
		Lincoln	176	1,666	86
		Otero	134	56,309	252
Northwest New Mexico	6	McKinley	117	31,599	0
		San Juan	0	0	0
		Cibola	193	13,654	964
Taos	7	Taos	101	20,178	0
Mora-San Miguel-Guadalupe	8	Mora	129	3909	0
		San Miguel	157	22,099	668
		Guadalupe	168	4,248	181
Colfax	9	Colfax	177	13,571	715
Lower Pecos Valley	10	Chavez	266	55,646	8,478
		De Baca	207	1,696	146
		Eddy	266	52,020	7,925
		Lincoln	186	16,772	1,052
		Otero (North)	113	2,015	0
		Otero (South)	0	0	0
Lower Rio Grande	11	Dona Ana	182	203,401	11,848
Middle Rio Grande	12	Valencia	134	43,659	196
		Bernalillo	155	635,124	17,787
		Sandoval	141	100,952	1,244
		Torrance	0	0	0
Estancia Basin	13	Bernalillo	51	695	0
		Santa Fe	80	570	0
		Torrance	133	10,942	37
Rio Chama	14	Rio Arriba	76	5580	0
Socorro-Sierra	15	Sierra	147	10,109	193
		Socorro	147	13,890	265
Lea County	16	Lea	230	51,352	5,753
Total Population Served by Public Water				1,700,000	
Total Potential Savings (ac-ft/year)					66,000

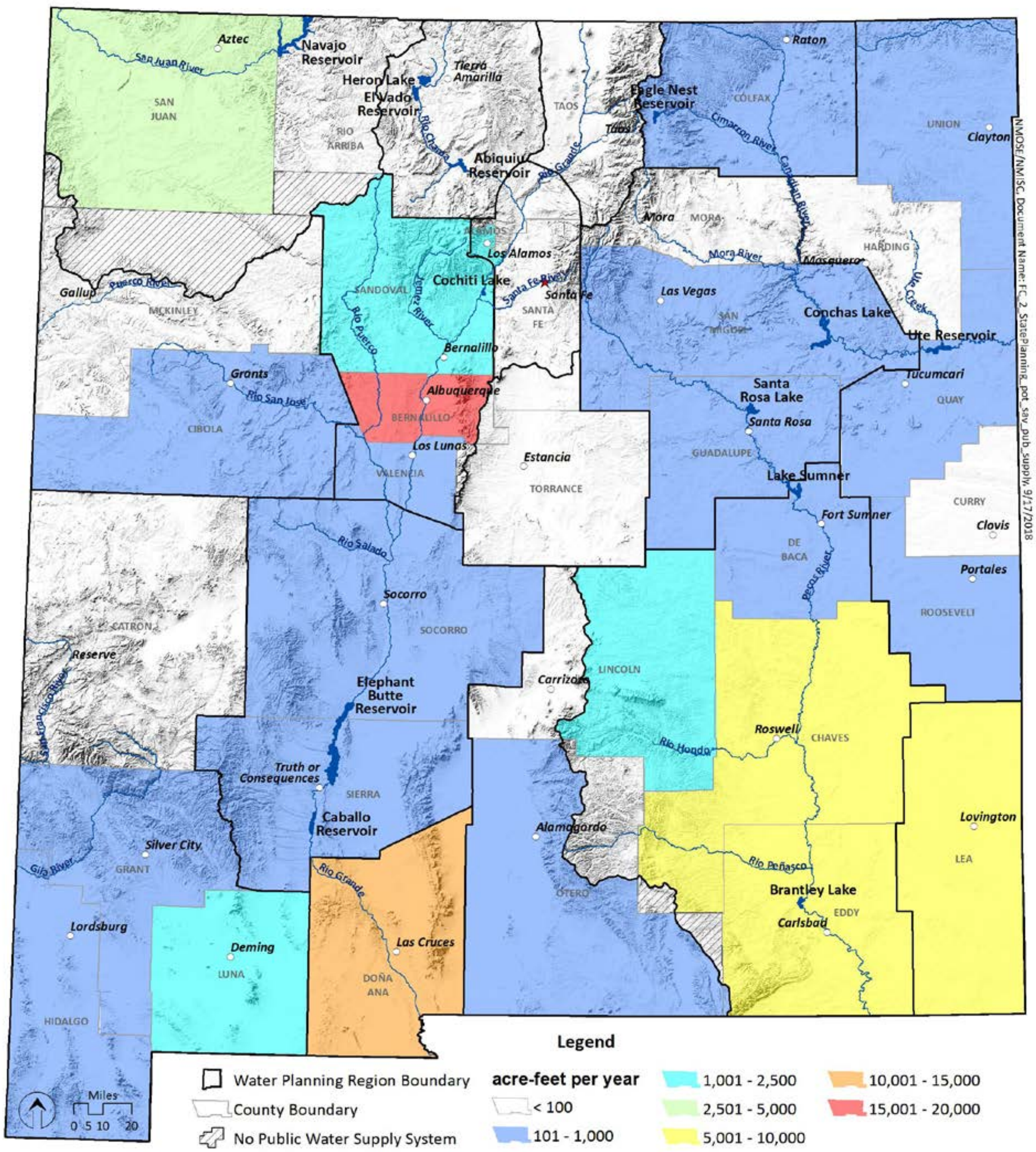

Figure 2C-2. Total Potential Savings by County if per Capita Demand Served by Public Water Systems is Reduced to 130 GPCD.

The PPP lists compiled by the water planning region steering committees for the Public Water Use category include 145 projects for reducing water demand to the community water systems. The PPPs can be summarized by four types: (1) water conservation programs, (2) metering, (3) water system infrastructure, and (4) wastewater reuse.

Water Conservation Programs

- Identified in: 11 out of 16 regions
- Number of PPPs: 50

Water conservation programs by public water systems include a range of strategies from education and incentives to enforcement. Educational programs help residential users understand how to save water through efforts such as calculating appropriate water use for landscaping, planting low-water-use landscape, designing methods of slowing runoff, or capturing rainfall. Some of the incentives include rebates for water-efficient appliances and tiered rate structures. Enforcement measures include fines for excessive use.

Metering

- Identified in: 11 out of 16 regions
- Number of PPPs: 42

Metering water use is an effective method to reduce water waste, and it is also a common basis for billing customers. Some public water systems have no fee or only charge a flat fee, resulting in a lack of incentive to conserve water. A total of 42 projects in the PPP lists address metering of water use in 11 out of 16 regions. Some of the projects involve meter replacement or calibration, and some are for installation of new meters.

Water System Infrastructure

- Identified in: 5 out of 16 regions
- Number of PPPs: 7

Water system infrastructure projects that reduce water losses will reduce the demand on water systems. Water pipes leading from wells and water treatment systems to residential and commercial customers can leak and waste water. Leaks are often detected through water audits that compare the amount of water produced from wells or diverted from surface water to the amount sold. Each water system will have some "non-revenue" water (usually about 12%, Vickers, 2002), due to flushing of fire hydrants and other losses.

Wastewater Reuse

- Identified in: 13 out of 16 regions
- Number of PPPs: 45

The reuse of treated effluent for irrigation of turf and other non-potable uses is widely accepted in New Mexico as a method to reduce the demand of potable water. The water rights surrounding the ownership of treated effluent must be examined for each public system before planning to reuse wastewater, and New Mexico Environment Department (NMED) regulations must be met with respect to the level of treatment and potential human exposure. Once these issues are addressed, the replacement of potable water with treated wastewater will reduce the demand on the water system. Conversely, selling treated effluent to other uses outside of the public water system may bring in revenue, but does not reduce the demand on the water system.

2C.2.2 Self-Supplied Domestic Use Category

Homeowners with private wells can achieve water savings through household conservation measures. Domestic wells are generally not metered unless the well serves more than one home or other regulations require metering (County Regulations or other); thus, quantifying the actual use and the potential savings is problematic.

One study in Santa Fe County (Lewis et al., 2013) examined meter records for 141 domestic wells connected to 291 homes and found that the per capita use averaged 177 gpcd with a median of 112 gpcd. The potential water savings was estimated by determining the water requirements for the existing landscape for the 161 homes served by the 71 metered wells (where the location of the homes could be identified). It was determined that if water-efficient irrigation methods were applied without changes to the area of the landscape, a 33% reduction in water demand could be realized. This estimated savings in water conservation translated to 1,872 ac-ft or 0.04 ac-ft per person per year for self-supplied within Jemez y Sangre planning region.

The water use estimates for the RWPs were developed based on a relatively low per capita use assumption for domestic wells, and therefore no additional conservation savings were assumed in developing the water demand projections. For purposes of developing projections, a county-wide per capita rate was calculated as the total self-supplied domestic use in the county divided by the total county population (or portion of the county within the region), excluding those served by a public water system.

An estimated 295,694 people are self-supplied by domestic wells statewide, or 14% of the population (Longworth et al., 2013). Some conservation programs address management of domestic wells generally, and many projects have already been implemented to restrict drilling of domestic wells within city boundaries or critical management areas, but no projects were identified in the PPP lists for targeting water conservation for self-supplied domestic homes. Some projects are focused on reducing water demand through roof-top harvesting, for example, which could apply to a home on a public water system or domestic well.

2C.2.3 Irrigated Agriculture Use Category

- Identified in: 11 out of 16 regions
- Number of PPPs: 34

As the largest water use in the state, conservation in this water use category may be beneficial. However, as explained in Appendix 2A, the potential for improved efficiency in agricultural irrigation systems is complicated, and it is important to consider how potential conservation measures may affect the region’s water supply.

Examination of the PPP lists for actions to reduce water demand within the agricultural water use category revealed a total of 34 projects in 11 out of 16 regions. The types of projects include water conservation programs, metering, wastewater reuse, and water system infrastructure. Agricultural water conservation programs can include exchange of high-water-use crops to low-water-use crops, exploring irrigation timing, methodology, laser leveling fields, metering, lining canals, and using treated effluent.

2C.2.4 Self-Supplied Commercial, Industrial, Livestock, Mining, And Power Water Use Categories

- Identified in: 2 out of 16 regions
- Number of PPPs: 2

Conservation programs can be applicable to these water use categories, but since uses are very low in these categories within the region, no additional conservation savings are assumed in the water demand projections. Examination of the PPP lists revealed 2 projects in 2 regions that addressed water reuse in industries.

2C.2.5 Reservoir Evaporation Use Category

- Identified in: 1 out of 16 regions
- Number of PPPs: 3

In many parts of New Mexico, reservoir evaporation is one of the highest consumptive water uses. To reduce usage in this category, some regions have considered underground storage and recovery to replace some reservoir storage, and it may also be possible in some circumstances to gain some reduction in evaporation by storing more water at higher elevations or constructing deeper reservoirs with less surface area for evaporation. Due to the legal, financial, and other complexities of implementing evaporation reduction techniques, no conservation savings are assumed in developing the reservoir evaporation demand projections for any region.

Examination of the PPP lists revealed 3 projects that address reducing evaporative losses from reservoirs, all of which are in the Lower Pecos Valley planning region. One project involves creating a berm around the shallow portions of lakes to reduce the surface area. Another project suggests storing water at higher elevations to reduce evaporative losses. The third project suggests using leaky reservoirs as recharge locations, not storage locations.

2C.3 DEVELOPING NEW SOURCES OF WATER SUPPLY

Mapping the horizontal and vertical boundaries of aquifers would greatly assist in identifying the potential of deeper untapped water supplies. Deep brackish water that is not hydrologically connected to existing freshwater supplies could serve as a new water supply, particularly during drought periods, but treatment costs can be high. Using produced water instead of fresh water for drilling and production of oil and gas wells could reduce the demand on fresh water.

New projects such as the Navajo-Gallup Water Supply Project and the Ute Reservoir Pipeline Project can provide additional supply, but legal and economic challenges make such projects difficult.

2C.3.1 Groundwater

- Identified in: 16 out of 16 regions
- Number of PPPs: 110

110 PPPs were included to improve the understanding of the water resources through monitoring, mapping, modeling, and other studies. While all these projects will improve the management of the groundwater resources, mapping the horizontal and vertical extent of aquifers would greatly assist the identification of deeper untapped water supplies. 23 of the PPPs are for quantifying the extent and quality of water supplies. The extent of deep brackish water that is not hydrologically connected to existing freshwater supplies could serve as a new water supply, particularly during periods of extended drought.

2C.3.2 Produced Water

- Identified in: 3 out of 16 regions
- Number of PPPs: 3

Produced water is water separated during the production of oil and gas. Produced water is generally from highly saline water sources and much of it is disposed of through evaporation or reinjected into the saline aquifers. Fresh water, brackish water, and municipal wastewater are often used in drilling and production of oil and gas wells and some produced water is recycled for drilling and production.

Operators of oil and gas wells are required by the Oil Conservation Division (OCD) of the New Mexico Energy, Minerals, and Natural Resources Department to report the volumes of water, oil, and gas produced from each production well and the volume of water injected. The quantities of produced and injected water reported to OCD are compiled in the Petroleum Recovery Research Center (PRRC, 2016) database.

It is important to note that injection wells can be used for disposal of produced water or for Enhanced Oil Recovery, which can include fracking or water flooding. Enhanced Oil Recovery has occurred for many decades but became much more prolific beginning in 2005 (Graham et al., 2015). Fracking involves a process of injecting sand and guar gum under pressure to open fractures in the geologic formation and then injecting chemicals (usually an acid and surfactants) to remove the injected fluid. Initially, the process required fresh water, but the process has changed in recent years such that highly saline water (up to 150,000 total dissolved solids [TDS]) can be used (Graham et al., 2015).

Figure 2C-3 shows the water inflows and outflows for the oil and gas production process. Graham et al. (2015) explored the potential for utilizing produced water instead of freshwater in the oil and gas production process. Graham et al. (2015) showed that in Lea County alone, about 14,000 ac-ft of fresh water a year was diverted in 2000 and 2005 for oil and gas production.

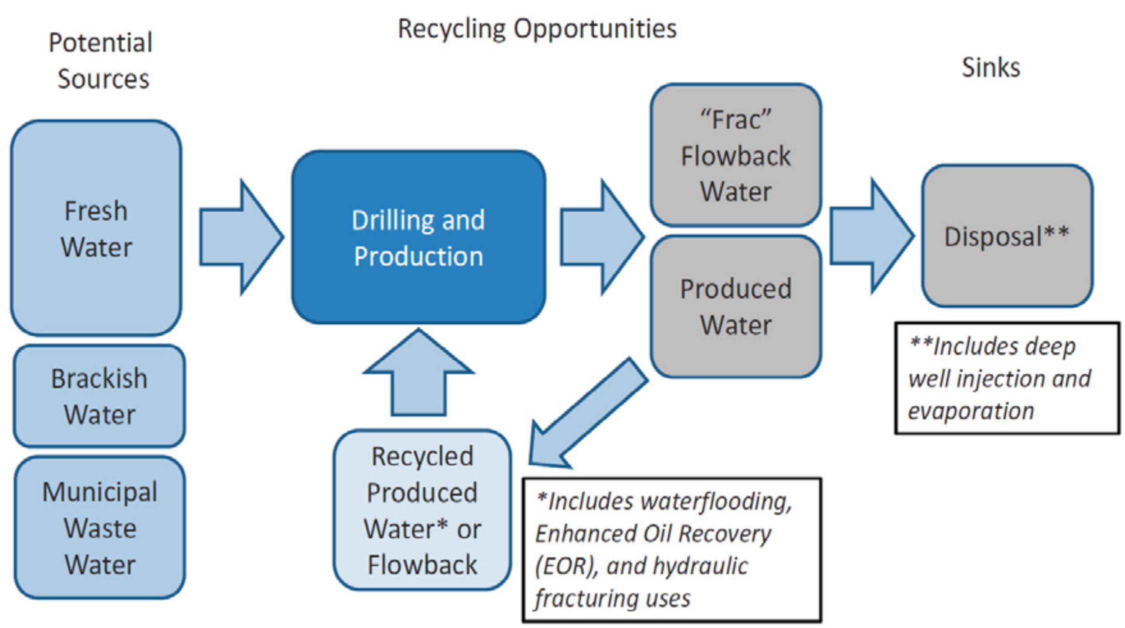

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Figure 2C-3. Recycling Opportunities for Produced Water (Graham et al., 2015).

In 2015, produced water totaled about 114,700 ac-ft, of which 108,900 ac-ft of was injected, resulting in a net depletion of 5,800 ac-ft (Table 2C-2). The net depletions may represent the total volume that is disposed of through evaporation rather than reinjected.

There were 3 projects in 3 regions on PPP lists for produced water from oil and gas, all about studying the possibility of using produced water. The Lower Pecos Valley RWP suggested that policy changes are needed to make the reuse of produced water more feasible, and that NMED regulations need to be re-evaluated to allow lower water quality standards for underground storage and recovery and direct Pecos River releases. Produced water research is ongoing in this region and supported by the Water Resources Research Institute (WRRI) and the Pecos Valley Water Users Organization.

Table 2C-2. Injected and Produced Water by County in New Mexico.

COUNTY	Injected Water 2015	Produced Water 2015	Net Water Depleted 2015
	ac-ft/yr	ac-ft/yr	ac-ft/yr
Chaves	1,439	2,712	1,273
Colfax	1,350	1,661	311
Eddy	31,018	35,085	4,067
Harding	3	6	3
Lea	70,891	69,805	(1,086)
McKinley	612	523	(89)
Rio Arriba	400	1,153	753
Roosevelt	227	247	20
San Juan	2,773	3,242	468
Sandoval	167	231	64
Union	8.8	10.4	2
TOTAL	108,889	114,675	5,786

Note: numbers in parentheses represent negative values

2C.3.3 Desalination

- Identified in: 5 out of 16 regions
- Number of PPPs: 9

In areas with limited fresh water supplies and ample brackish or saline aquifers, such as the Tularosa-Sacramento-Salt Basins planning region, efforts to desalinate the brackish water for potable supply in a cost-effective manner can help increase the water supply to a region. The City of Alamogordo is leading such an effort. City leaders are also interested in working with the New Mexico Institute of Mining and Technology and Otero County to map fresh water and brackish water.

The New Mexico Desalination Association is working to promote and assist the desalination industry in developing professional and stakeholder knowledge of desalination approaches, technologies, and costs. Alamogordo is the largest community in New Mexico with a desalination plant (currently under construction in 2018). The largest inland desalination plant in the world is in El Paso, Texas, just south of the border with New Mexico.

Capital costs vary on the size of the plant, while operation and maintenance costs vary based on the salinity of the water. Lead time to design, permit, build, and secure funding for a desalination plant requires many years (18 years for Alamogordo). Some companies offer portable desalination systems for treating up to 1 million gallons per day and could be set up and contracted within a month for emergency operation if the necessary water rights are available and other permitting requirements are obtained (Hightower, 2018).

2C.3.4 New Water Supply Projects

- Identified in: 14 out of 16 regions
- Number of PPPs: 64

Developing new water projects and developing new sources of supply were presented in many of the PPP lists. A total of 57 of the PPPs involve drilling new wells in 14 of the regions. In some cases, the drilling of a new well may replace an existing well and only improve the system efficiency, or the new well is tapping into the same aquifer; thus, it is not exactly a “new supply”. However, if a well is drilled to access new water rights, then the new well does represent the development of a new supply.

New water projects require water rights (and wet water supply). Four significant regional water supply projects will impact the available water supply for public water systems to some of the regions (as shown in Figure 2C-4):

The San Juan-Chama Project

The San Juan-Chama Project, completed in 1976, provides up to 96,200 ac-ft of water per year of a portion of New Mexico’s Upper Colorado River Basin Compact allocation to nations, tribes, and pueblos, the cities of Albuquerque and Santa Fe, multiple communities, and the Middle Rio Grande Conservancy District in the Rio Grande Basin upstream of Elephant Butte Dam. Most of the water supplied by the project is diverted or used for offsets by the various project contractors, but some, such as Los Alamos, have yet to utilize their allocation. San Juan-Chama Project water will also be utilized to resolve the Nambe-Tesuque-Pojoaque and Taos Settlements.

Navajo–Gallup Water Supply Project (part of the Northwestern New Mexico Rural Water Projects)

The Northwestern New Mexico Rural Water Projects Act (Public Law 111-11, Title X, Subtitle B), which was passed by Congress and signed into law in March 2009, approved an agreement between the State of New Mexico, the Navajo Nation and the United States defining the nature and extent of the Navajo Nation’s rights to the waters of the San Juan River Basin in New Mexico (San Juan Navajo Water Rights Settlement) and authorized construction of the Navajo-Gallup Water Supply Project to service municipal and domestic water demands of the Navajo Nation, the Jicarilla Apache Nation, and the City of Gallup.

The Act also authorizes funding for rehabilitation of the Hogback and Fruitland irrigation projects on Navajo Reservation lands in the San Juan River valley. A final San Juan Navajo Water Rights Settlement conforming to the provisions of the Act and a related Navajo Reservoir water supply contract for the Navajo Nation were executed in December 2010. In November 2013, the Court in the San Juan River Adjudication entered two significant rulings:

1. A Partial Final Judgment and Decree of the Water Rights of the Navajo Nation (Navajo Decree) defining the rights of the Navajo Nation in New Mexico to divert and use water from the San Juan River, including Navajo Reservoir, and from the Animas River and groundwater
2. A Supplemental Partial Final Judgment and Decree of the Water Rights of the Navajo Nation (Navajo Supplemental Decree) defining the rights of the Navajo Nation in New Mexico to divert, store, and use waters from ephemeral tributaries to the San Juan River, including in the Chaco River drainage.

The Northwestern New Mexico Rural Water Projects Act also authorized funding of up to $11 million to be appropriated through federal fiscal year 2019 for the repair, rehabilitation, or reconstruction of non-Navajo irrigation diversion and ditch facilities in the San Juan River Basin in New Mexico to improve water use efficiency. The application of federal funding for such improvements to irrigation canal distribution systems and on-farm irrigation practices is subject to 50% non-federal cost-sharing.

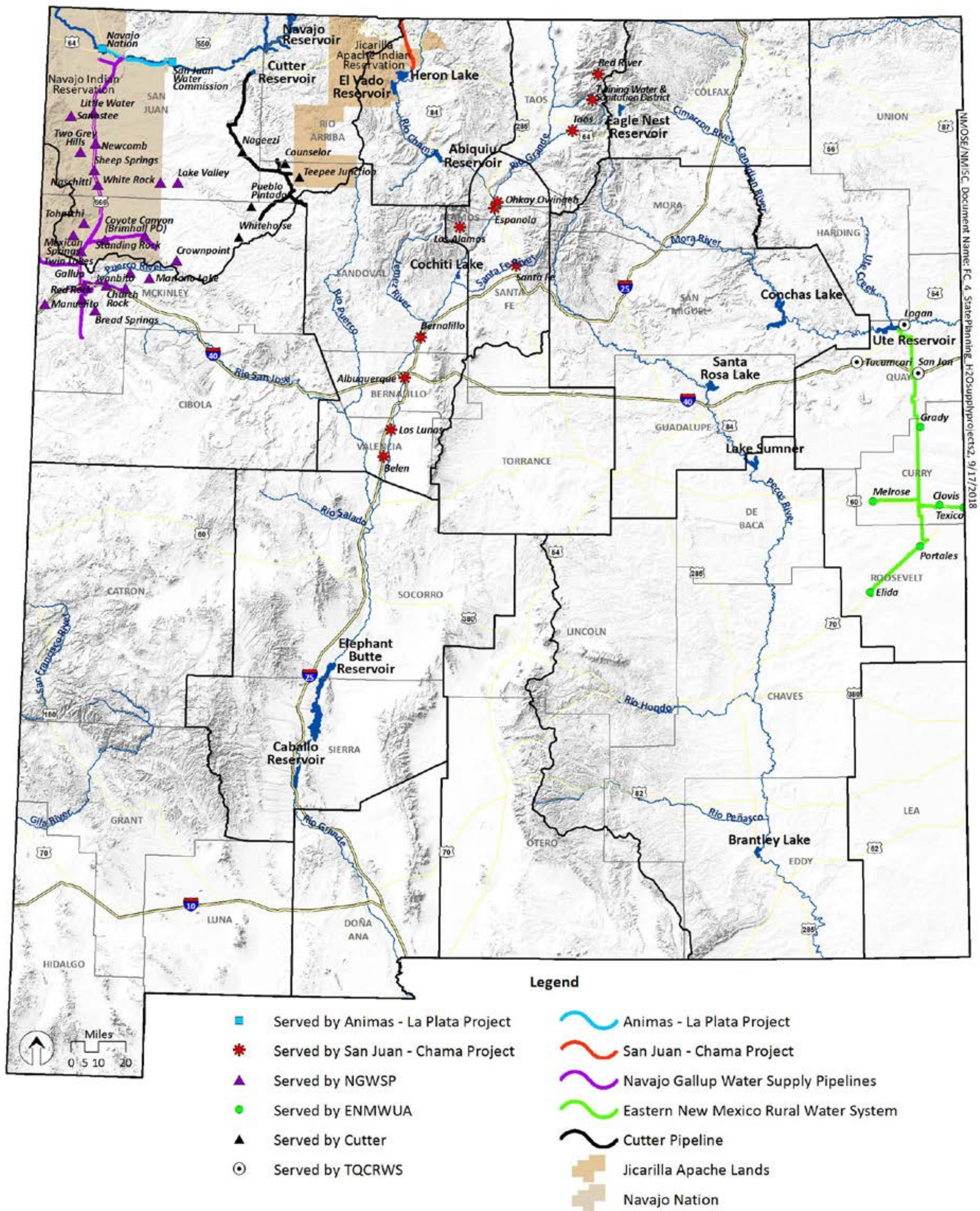

Figure 2C-4. Water Supply Projects for Public Water Systems in New Mexico.

Animas-La Plata Project

The Animas-La Plata Project was completed by the United States Bureau of Reclamation in 2011. The Animas-La Plata Project will provide water supplies for municipal, industrial, and domestic uses in Colorado and New Mexico. Lake Nighthorse, the pumped-storage facility for the Animas-La Plata Project, was completed and filled by June 2011 with a total storage capacity of 123,500 ac-ft. The reservoir will provide roughly 90,000 ac-ft of active storage to help meet future municipal and domestic water demands of non-Indian water providers in New Mexico and the Navajo Nation, and water users in Colorado.

Eastern New Mexico Rural Water System and Tucumcari Quay County Regional Water Authority

The Eastern New Mexico Rural Water System and the Tucumcari Quay County Regional Water Authority projects in eastern New Mexico will serve the communities of Clovis, Cannon Air Force Base, Portales, Elida, Melrose, Grady, Tucumcari, and Logan; and will deliver 24,000 ac-ft of surface water from Ute Reservoir. On March 1, 1997, the ISC entered into a contractual agreement with the Ute Reservoir Water Commission to provide up to 24,000 ac-ft/yr of water from Ute Reservoir.

The Eastern New Mexico Water Utility Authority anticipates completing construction of the Eastern New Mexico Rural Water System project within the next 10 years. The Ute Reservoir Water Commission was formed by a joint powers agreement in 1996 to serve as a viable organization for the planning, development, and acquisition of water from Ute Reservoir. The Ute Reservoir Water Commission allocated this water to its member entities for municipal and industrial supply as follows:

- City of Clovis: 12,292 ac-ft (including Cannon Air Force Base, which has a long-term lease agreement with the City of Clovis for a portion of the City's reservation)
- Curry County: 100 ac-ft
- Village of Elida: 50 ac-ft
- Village of Grady: 75 ac-ft
- Village of Melrose: 250 ac-ft
- City of Portales (3,333 ac-ft)
- Roosevelt County (100 ac-ft)
- Village of Texico (250 ac-ft)
- Quay County (1,000 ac-ft)
- Tucumcari (6,000 ac-ft)
- Logan (400 ac-ft)
- San Jon (150 ac-ft)

Arizona Water Settlement Act—Gila and San Francisco River System

Several legal ruling and Congressional acts regulate New Mexico's use of water on the Gila/San Francisco River system:

- The 1964 *Arizona v. California* Decree issued by the U.S. Supreme Court effectively limits new or large water development projects in the Gila or San Francisco sub-basins.
- The 1968 Colorado River Basin Project Act allocated an additional 18,000 ac-ft per year of consumptive use to New Mexico for use in the Gila and San Francisco River basins, allowing for a total of approximately 48,000 ac-ft per year of consumptive use. This act also authorized the Central Arizona Project (CAP).

- The 2004 Arizona Water Settlement Act (AWSA) reduced the 1968 allocation from 18,000 to 14,000 ac-ft per year of annual average consumptive use, resolved the issue of New Mexico's junior priority, and included funding of up to $128 million.

The AWSA provides the following:

> "in the operation of the Central Arizona Project, the Secretary shall offer to contract with water users in the State of New Mexico, with the approval of its Interstate Stream Commission, or with the State of New Mexico, through its Interstate Stream Commission, for water from the Gila River, its tributaries and underground water sources in amounts that will permit consumptive use of water in New Mexico of not to exceed an annual average in any period of 10 consecutive years of 14,000 ac-ft, including reservoir evaporation, over and above the consumptive uses provided for by article IV of the decree of the Supreme Court of the United States in *Arizona v. California* (376 U.S. 340). Such increased consumptive uses shall continue only so long as delivery of Colorado River water to downstream Gila River users in Arizona is being accomplished in accordance with the AWSA, in quantities sufficient to replace any diminution of their supply resulting from such diversion from the Gila River, its tributaries and underground water sources. In determining the amount required for this purpose, full consideration shall be given to any differences in the quality of the water involved."

The AWSA also gave New Mexico $66 million to finance a New Mexico Unit or other water utilization project in the Southwest New Mexico planning region. Initial funding became available beginning in 2012 and is being paid to the New Mexico Unit Fund in annual increments.

In November 2014, in accordance with the AWSA, the ISC provided notice to the Secretary of the Interior that New Mexico intends to have a New Mexico Unit of the CAP constructed or developed. In 2014 and 2015, the ISC also voted to partially fund additional water-use projects in the region:

- Municipal water conservation: $3 million
- Gila Basin Irrigation Commission diversion structure: $1.25 million
- Catron County Community Ditch permanent points of diversion: $500,000
- Deming effluent reuse: $1.75 million
- Pleasanton East-Side Ditch Company ditch improvement: $200,000
- Sunset Canal and New Mexico New Model Canal ditch improvements: $200,000 (in 2016 Sunset Canal renounced its share of the funding and asked that it be transferred to New Model)
- 1892 Luna Irrigation Ditch Association permanent diversion structure: $100,000
- Grant County Regional Water Supply Project: $2.1 million

The AWSA provides for the designation of a New Mexico CAP Entity to own and hold title to the New Mexico Unit of the CAP. The Entity was designated by the ISC and created through a Joint Powers Agreement among the participating local governments in July 2015.

The New Mexico CAP Entity is continuing to plan for the development of a New Mexico Unit project, which must be designed to comply with the terms of the AWSA. Environmental and planning studies, including preparation of an environmental impact statement by the ISC and the United States Bureau of Reclamation, must be completed before construction. The AWSA allows New Mexico to be a joint lead in the National Environmental Policy Act process. Information on the process is available on the New Mexico AWSA website (http://www.nmcapentity.org). Steering committee support for this project is mixed, with some strong supporters but others in the group voicing strong opposition (refer to Southwest New Mexico RWP). Even if no New Mexico CAP Unit is built, up to $66 million of the $128 million may be used for projects that meet water demand in the Southwest New Mexico planning region.

2C.4 OTHER GAP MANAGEMENT STRATEGIES

Some other gap management strategies have been suggested by steering committees, such as transfer of water rights from agricultural water use to urban use to meet growing demand in population centers or importing water from one water planning region or surface water basin to another, or even from one state to another. Projects under consideration or discussion include transfers from the Gila River, Rio Grande, Nutt-Hockett Basin, or Salt Basin; reuse of produced water and transfer to another area; or import from the Columbia, Mississippi, or other large river basins in other regions of the United States.

Transfer Water Rights

- Identified in: 10 out of 16 regions
- Number of PPPs: 29

Water rights transfers from one purpose of use to another are one mechanism for meeting future demands (at the expense of the transferred-from use). Of the 29 water right transfer projects, programs, or policies included in the PPP lists for 10 of the regions, all but 1 project involves the transfer of water rights from agricultural water use to urban use, which includes purchase of unused mining water rights for agriculture.

Inter-Basin Transfers

- Identified in: 5 out of 16 regions
- Number of PPPs: 2

Inter-basin transfers involve importing water from outside of the water planning region, or from one groundwater basin or surface water basin to another. A total of 5 projects from 2 water planning regions are in the PPP lists that involve importing water. Region 10, the Lower Pecos Valley planning region, includes conceptual ideas of exploring for unappropriated water in New Mexico for import to the Lower Pecos Valley planning region and considering importing water from major rivers outside of New Mexico. Region 11, Lower Rio Grande planning region, is interested in importing water from the Gila Project, Nutt-Hockett Basin, and the Salt Basin.

Shortage Sharing Agreements

- Identified in: 2 out of 16 regions
- Number of PPPs: 2

Shortage sharing agreements between parties on a stream or ditch provide an alternative to priority administration during periods of drought. 2 projects on the PPP lists involve developing shortage sharing agreements for drought mitigations.

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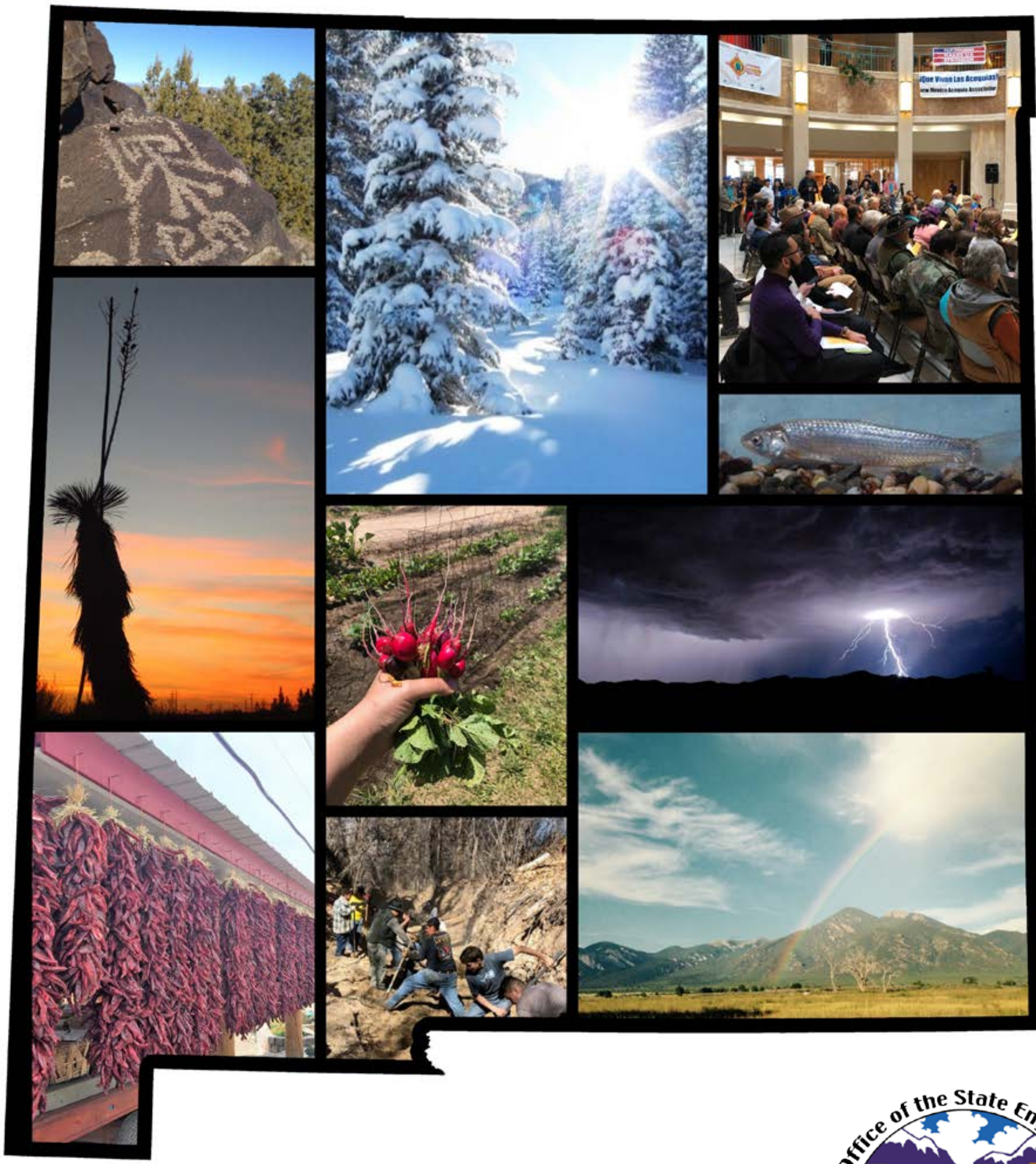
New Mexico State Water Plan
Part III: Legal Landmarks

Gaining a Statewide Perspective through Analysis and Integration of Water Planning Activities, Including New Mexico's 16 Regional Water Plans



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Interstate Stream Commission

Adopted by the New Mexico Interstate Stream Commission

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New Mexico State Water Plan Part III: Legal Landmarks

Prepared by the New Mexico Interstate Stream Commission

Published 2018

The 2018 New Mexico State Water Plan is presented in three parts:

Part I: Policies presents a concise, big-picture view of the highest priority water issues in New Mexico and the policies, goals, and strategies needed to address them, as well as information about the agencies and resources available to assist with these issues.

Part II: Technical Report integrates water resource information from the Regional Water Plans completed in 2016-2017, including estimated water supply and demand, projections of population, and strategies proposed by stakeholders to address key water issues.

Part III: Legal Landmarks provides information about historical New Mexico water law decisions, events, and circumstances that shaped New Mexico's legal structures for water resource administration.

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List of Acronyms

AWRM	Active Water Resource Management
CWA	Clean Water Act
ESA	Endangered Species Act
ISC	New Mexico Interstate Stream Commission
NEPA	National Environmental Policy Act
NMAC	New Mexico Administrative Code
NMSA	New Mexico Statutes Annotated
NMSC	New Mexico Supreme Court
OSE	New Mexico Office of the State Engineer
Reclamation	United States Bureau of Reclamation
U.S.C.	United States Code
USSC	United States Supreme Court
WQA	Water Quality Act

1. Introduction

This *2018 New Mexico State Water Plan Part III: Legal Landmarks* provides information about historical New Mexico water law decisions, events, and circumstances that shaped New Mexico's legal structures for water resource administration.

1.1 Purpose of the 2018 New Mexico State Plan Part III: Legal Landmarks

This part of the *2018 New Mexico State Water Plan* is intended to provide a background understanding of the fundamentals of water law and administration in New Mexico in order to help the reader understand some of the basic concepts involved in managing water resources. In addition, knowing more about New Mexico water law history may assist water planners and water users in gaining understanding of the background and purposes of this current State Water Plan.

1.2 Overview of Legal Landmarks

This *2018 New Mexico State Water Plan Part III: Legal Landmarks* provides information about historic principles and events that shaped New Mexico's legal structure for water resource administration.

This document includes 12 topics, starting with the concepts of prior appropriation and beneficial use (Section 2) and the structure for administering water use in the state (Sections 3 through 5, 8, 10, 13) discussions of interstate compacts (Section 6), flood control (Section 7), management of the groundwater-surface water connection (Section 8), quantification of Native American water rights (Section 10), environmental protection (Section 11) and concluding with a discussion of state water planning (Section 13).

2. Guiding Principles in New Mexico Water Law

Two principles govern New Mexico water law.

1. "prior appropriation shall give the better right," N.M. Const. art. XVI, Sec 2, means that the water right owner whose right was established first will get water first in times of scarcity. The earlier the priority date of a water right, the more likely it is to get a full supply of water.
2. "beneficial use shall be the basis, the measure and the limit of the right to the use of water," N.M. Const., art. XVI, Sec. 3. This means that the private[1] property of a water right is only in the use of water for a beneficial purpose. That property right only exists to the extent of historic beneficial use, and only as long as water under that right continues to be beneficially used. New Mexico states no preferences for one type of use over another.

Both of these principles look to history, first as to when a water use began and then as to how much water was historically used and continued to be used. In addition to these fundamental principles, there are other statutory

[1] The water itself is owned by the public. N.M. Const. art. XVI, Sec 2.

provisions, events, and court decisions that have shaped the way New Mexico governs water. This third part of the State Water Plan describes some of these landmarks.[2]

3. The 1907 Water Code

In 1907, the Territory of New Mexico passed the comprehensive water code that still forms the basis for much of New Mexico water law, NMSA 1978 Chapter 72. The 1907 Water Code officially declared the two fundamental principles of New Mexico water law—prior appropriation and beneficial use—anticipating their inclusion in the New Mexico Constitution, which New Mexico adopted with statehood in 1912.

Although these principles had been part of New Mexico law for many years prior to 1907, the precise language of the 1907 Water Code was largely based on a draft model water code written by an employee of the United States Reclamation Service (now the United States Bureau of Reclamation [Reclamation]). Reclamation was formed in 1902 under the Reclamation Act, 57 P.L. 161, 32 Stat. 388, 57 Cong. Ch. 1093, 57 P.L. 161, 32 Stat. 388, 57 Cong. Ch. 1093. This act promoted the construction of large irrigation projects throughout the West, including infrastructure such as dams.

Many New Mexico lawmakers were motivated to smooth the way for United States resources to be allocated to New Mexico to build the large irrigation projects promoted by Reclamation. In part, New Mexico's 1907 Water Code was designed to ensure that the State had sufficient practical administrative and judicial authority and understanding regarding water resources that Reclamation would feel confident that those resources could be developed in an orderly way. This administrative and judicial authority was established through a variety of strategies, including four described below that continue to be important today.

3.1 The Broad Authority of the State Engineer

The New Mexico Water Code of 1907 greatly increased the authority of the water official for the Territory of New Mexico. The historian Ira Clark, in his detailed and distinguished work Water In New Mexico (1987) (Albuquerque: University of New Mexico Press 1987), begins his analysis of the 1907 Water Code by stating that its most "striking feature" was the expansion of the powers of the [then Territorial] Engineer. Clark observes that, in the 1907 Water Code, the Engineer's:

> overall responsibilities were covered by a sweeping statement: 'He [sic] shall have general supervision of the waters of the Territory and of the measurement, appropriation, and distribution thereof, and such other duties as are required by this act.'
>
> Clark, at 119. *See* NMSA §72-2-1.

The extensive, centralized authority of the State Engineer has been a constant theme of New Mexico water law. In 2009, in *Lion's Gate Water v. D'Antonio*, 2009-NMSC-057, 147 N.M. 523, 226 P.3d 622, the New Mexico Supreme Court (NMSC) confirmed that the 1907 Water Code granted the State Engineer broad authority over water in New Mexico and described the legislative intent in so doing:

[2] The events and landmarks discussed here are not exhaustive but are intended to give a rough framework for understanding New Mexico water law.

> The general purpose of the water code's grant of broad powers to the State Engineer, especially regarding water rights applications, is to employ his or her expertise in hydrology and to manage those applications through an exclusive and comprehensive administrative process that maximizes resources through its efficiency, while seeking to protect the rights and interests of water rights applicants.
>
> *Lion's Gate,* at 532-3.

3.2 Application Processes before the State Engineer

Water rights applications were a second great change made by the 1907 Water Code. In New Mexico, surface water uses that were made before March 20, 1907—the date the Water Code came into effect—established a water right simply by diverting and using before that date, providing that the water use was continuous after that date. However, following the passage of the 1907 Water Code, the exclusive means for establishing a new water right was through an application process before the State Engineer. New uses of surface water initiated without a permit or license from the State Engineer became illegal.

The creation of the State Engineer permitting process in 1907 contributed to New Mexico's authority and understanding regarding its water by providing for a centralized perspective on water. From this centralized perspective, the 1907 Code requires the State Engineer, before granting a permit, to determine that the proposed new water right can be satisfied within the supply of available, unappropriated water, *see*[3] NMSA §72-5-6, thus reducing potential conflicts that could arise from over-appropriation.

In addition, the application process includes an opportunity for affected third parties to protest an application before the State Engineer. *E.g.* NMSA §72-5-5. Because of the flowing nature of water, the new statute required that the State Engineer would hear the concerns of neighbors, if there were any, in considering the effects of a proposed new water use.

3.3 The State Engineer's Technical Expertise

The 1907 Water Code requires that the State Engineer be a qualified and registered professional engineer. *See* NMSA §72-2-1. The New Mexico 1907 Water Code was passed during a period of American history known as the Progressive Era, between the 1890s and the 1920s. During that time, great hopes were placed on engineers, scientists, and others with technical training to make the world better.

One historian of irrigation in the United States remarked of the time that "[t]he engineer was the master of technology—and the logical arbiter of economic progress. The scientific method made him a rationalist free of bias, suited both to lead and to mediate between economic interests and conflicting classes." *See* Donald J. Pisani, Water and American Government: The Reclamation Bureau, National Water Policy, and the West, 1902-1933 (University of California Press, 2002, p. 24).

[3] As discussed in Section 12 below, statutory changes in the 1980s required the State Engineer, before approving a permit, to make additional findings that the proposed new water right would not be contrary to the public welfare or detrimental to the conservation of water in the state. *E.g*., NMSA §72-5-6.

The New Mexico 1907 Water Code envisioned that determinations regarding water would be made in accordance with scientific principles. *See also, Lion's Gate, supra*, at 533 (the NMSC notes that the purpose of the broad powers given to the State Engineer was for the State Engineer to use an "expertise in hydrology" in water administration decisions).

3.4 Water Rights Adjudications through the Courts

The 1907 Water Code places one aspect of water law in the courts rather than the State Engineer. While water rights are administered through State Engineer processes, they are adjudicated through the courts. The 1907 Water Code created a statutorily defined type of lawsuit, often called a "water rights adjudication." *See* NMSA §72-4-13 *et seq.* Section 9 includes more information about modern water rights adjudication.

These lawsuits judicially determine water rights in a single proceeding for an entire stream system, which means that they often involve thousands of defendants. The State Engineer acts as a technical expert in the adjudication, providing a hydrographic survey to ensure that court decisions have a solid factual and technical foundation. *See* NMSA §72-4-16. Thus, although the duties of water administration and water adjudication have been split between the State Engineer and the courts, the statutes still guarantee that the State Engineer's technical expertise will inform the adjudication process.

4. Working with Acequias and Special Districts

One of the special features of New Mexico water law is the working partnership that the statutes promote between the centralized and scientific duties of the State Engineer and the local autonomy embodied both in New Mexico's acequias and in other special water districts in the state.

While the State Engineer applies technical expertise to a centralized administrative process and may appoint local officials as water masters to distribute water in accordance with established water rights, *see* NMSA §72-3-1 *et seq*., other water-related local governing bodies also have an essential role in New Mexico water administration.

4.1 The Unique Law of Acequias

Long before the 1907 Water Code, acequias were well-established in New Mexico. Acequias are governed by a separate set of laws within the 1907 Water Code, many of which pre-date 1907. These laws recognize the autonomy of acequias and set the conditions for the officers of the acequia to distribute water along the ditch. *See* NMSA §73-2-1 *et seq*.

The "mayordomo" of an acequia, for example, is a local official invested with authority by the water users on the ditch. The mayordomo is the executive officer of the acequia, reporting to a governing commission. *See* NMSA §73-2-21. Thus, acequias continue to have a proud tradition of "local control and discretionary authority." *See* Rivera, Jose A., Acequia Culture: Water, Land and Community in the Southwest (Albuquerque, NM, 1998, pp. 4-5).

4.2 Allowing for Special Districts

New Mexico statutes recognize and allow for a variety of types of special districts related to water and water uses. For example, water rights owners may form irrigation districts to regulate themselves with regard to irrigation. NMSA §73-9-1 *et seq.* Some irrigation districts are especially intended to work with Reclamation on federal irrigation projects and are subject to somewhat different statutes. E.g., NMSA §73-10-1 *et seq.*; NMSA §73-11-1 *et seq*. The Elephant Butte Irrigation District, for example, was created in 1919 to partner with the federal Rio Grande Project, pursuant to which Elephant Butte reservoir was built.

Conservancy districts, which may also be organized by individuals under State statutes, have as their chief purposes flood control and flood protection, although they may also serve other water interests. *See* NMSA §73-14-1 through 73-19-5. The Middle Rio Grande Conservancy District, for example, was formed in 1923 to provide flood protection from the Rio Grande and to drain swamp lands, as well as to deliver irrigation water to farmlands. Soil and Water Conservation Districts, *see* NMSA §73-20-25 *et seq.*, have a variety of powers with regard to water, including promoting and adopting different types of natural resource development planning. *See* NMSA §73-20-44.

In addition to these special districts, the statutes provide for artesian conservancy districts, e.g., NMSA §73-1-1 *et seq.*, drainage districts, NMSA §73-6-1 *et seq.*, and others.

5. Negotiating and Managing Interstate Compacts

5.1 The Purpose of Compacts

As Reclamation built dams along major rivers in the West, the western states became concerned about ensuring that each state got its fair share of water supply from any river that flowed across state boundaries. For this reason, starting in the 1920s, the states began to negotiate interstate agreements regarding water. These agreements became known as "interstate compacts," which can be entered into under the Compact Clause of the United States Constitution, Art. 1, §10, Cl 3 (no state shall enter into any agreement or compact with another state except with the consent of Congress). Where the Compact Clause is invoked, interstate compacts are generally enacted into both state and federal law.

New Mexico is a party to eight interstate compacts—the Canadian River Compact, the Colorado River Compact, the Upper Colorado River Basin Compact, the La Plata River Compact, the Rio Grande Compact, the Costilla Creek Compact, the Pecos River Compact, and the Animas-La Plata Project Compact. All of these are codified in the New Mexico statutes at Article 15 of Chapter 72.

The compacts define New Mexico's share of the rivers that flow into and out of the state. Figure 1 shows a map of New Mexico's compacts.

Often a compact contains a statement of purpose, like this one from the Canadian River Compact:

> The major purposes of this compact are to promote interstate comity; to remove causes of present and future controversy; to make secure and protect present developments within the states; and to provide for the construction of additional works for the conservation of the waters of the Canadian river.
>
> NMSA §72-15-2, Art. 1

In addition to New Mexico's compact obligations with other states, the United States has entered into two agreements with Mexico that apportion the waters of those basins between the two countries, *see* the Convention of 1906, 34 Stat. 2953, and a 1944 Treaty, 59 Stat. 1219.

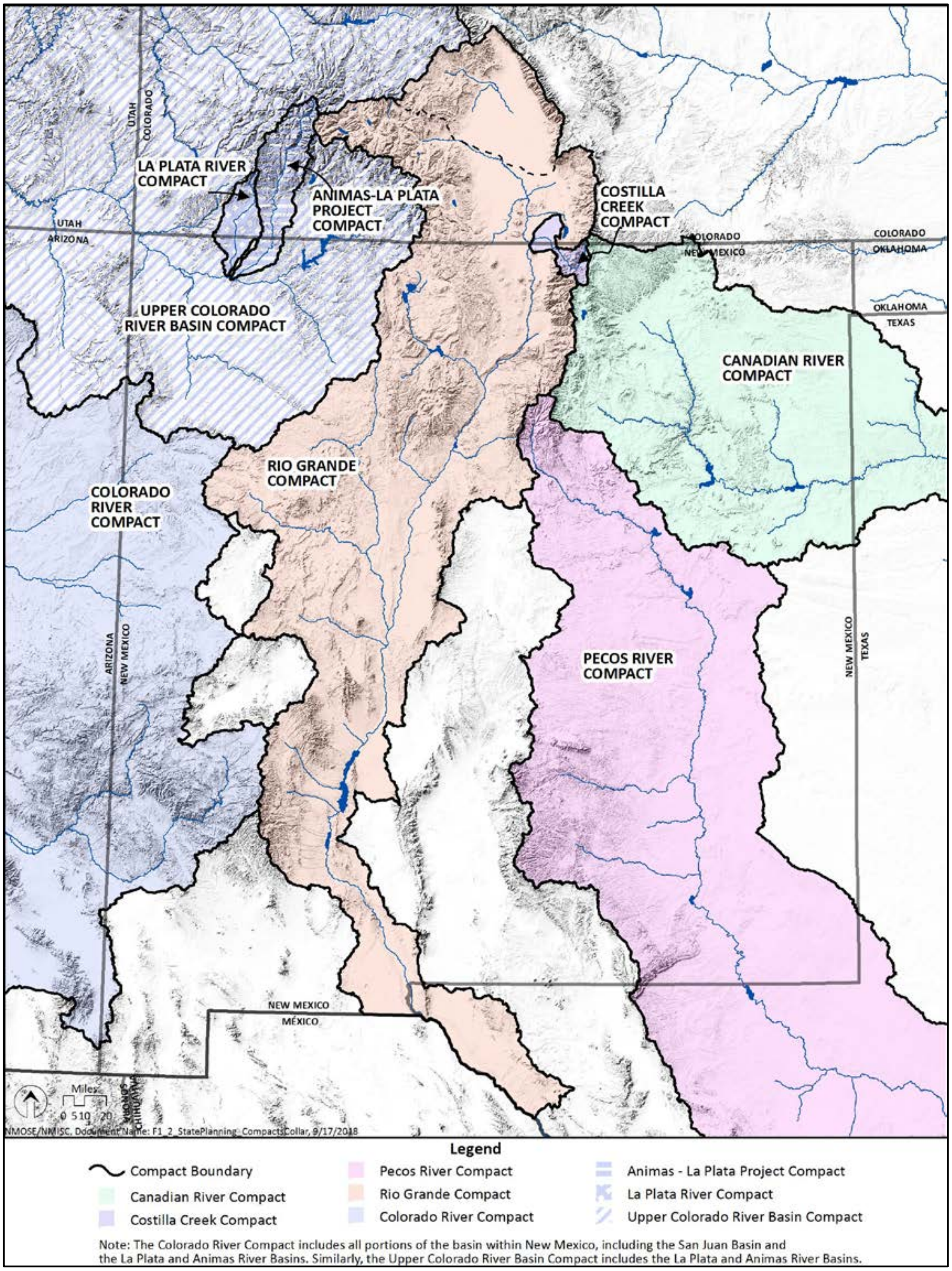

Figure 1. Interstate Compacts with Neighboring States.

5.2 Managing Interstate Compacts

Despite the purpose of avoiding controversies, lawsuits have arisen over the meanings of various interstate compacts. One state party to a compact may sue another state party to that compact, claiming that the compact has been violated. *E.g., Texas v. New Mexico*, No. 65 (Original) (the Pecos River litigation).

Under the United States Constitution, when a state of the Union sues another state of the Union, the first court that hears the lawsuit is the United States Supreme Court (USSC). This is known as "original jurisdiction."[4] US Const. Art. III, § 2, Cl 2. New Mexico has been party to several original jurisdiction cases regarding interstate compacts. For example, in the Pecos River compact litigation begun in 1973, Texas claimed that New Mexico had violated the Pecos River Compact, NMSA §72-15-19. In 1988, the USSC entered an Amended Decree that appointed a federal River Master for the Pecos Compact, and established an accounting method to verify the apportionment of Pecos River flows between New Mexico and Texas. *Texas v. New Mexico*, 485 U.S. 388 (1988). Since that time, New Mexico has expended enormous amounts of time, effort, and money to ensure that New Mexico remains in compliance with the requirements of the 1988 Amended Decree.

Most recently, in 2013, Texas sued New Mexico in the USSC over the Rio Grande Compact, NMSA §72-15-23 (Rio Grande Compact); *Texas v. New Mexico*, No. 141 (Original). The case has the potential to affect water administration in the Lower Rio Grande. *N.B.*, Article XVI of the Rio Grande Compact clarifies that nothing in the compact can affect the obligations of the federal government to Native American nations, tribes or pueblos or impair the rights of nations, tribes, or pueblos. See Section 10 for more information about Native American water rights.

New Mexico takes its duty of compact compliance very seriously. In NMSA §72-2-9.1, the New Mexico legislature, "recognize[d] that . . . compact compliance is *imperative* . . .. (emphasis added)." Compact compliance is an overriding concern for all water planning.

6. Forming the Interstate Stream Commission

The New Mexico Interstate Stream Commission (ISC) was created in 1935, with the following purposes and authority:

> . . . to negotiate compacts with other states to settle interstate controversies or looking toward an equitable distribution and division of waters in interstate stream systems, subject, in all cases, to final approval by the legislature of New Mexico; to match appropriations made by the congress of the United States for investigations looking to the development of interstate streams originating in or flowing through the state of New Mexico; to investigate water supply, to develop, to conserve, to protect and to do any and all other things necessary to protect, conserve and develop the waters and stream systems of this state, interstate or otherwise; to institute or cause to be instituted in the name of the state of New Mexico any and all negotiations and/or legal proceedings as in its judgment are necessary to carry out the provisions of this act [72-14-1 to 72-14-3 NMSA 1978]; to do all other things necessary to carry out the provisions of this act . . .
>
> NMSA §72-14-3.

[4] Original jurisdiction cases are unusual—there have been fewer than 150 such cases in the history of the United States. Most cases before the USSC are elevated there after appeals from lower courts, and only when the USSC has exercised its discretion to decide to hear that case. In contrast, the USSC is constitutionally required to hear original jurisdiction cases.

The ISC presently consists of nine members, eight appointed by the governor. The State Engineer is the ninth member, serving as *ex officio* secretary of the ISC. *See* NMSA §72-14-1. The ISC has monthly meetings to which the public is welcome.

Under NMSA §72-14-3.3, the ISC has established and administers the strategic water reserve, which assists in compliance with interstate compacts, as well as with water management within the state. In addition, the ISC administers State funding for certain water infrastructure projects through specific programs, including the acequia cost-share program and acequia capital outlay projects.

In 2003, the legislature tasked the ISC with creating the New Mexico State Water Plan. *See* NMSA §73-14-3.1. The statute embodying this direction requires that the State Water Plan be updated every five years. *Id.* At (H). Other parts of the statute ensure that the State Water Plan is based on sound science and accepted water planning expertise. Under NMSA §72-14-3.2 (E), a regional water plan accepted by the ISC must be referenced in any water conservation plan submitted to the State Engineer.

7. Responding to and Planning for Severe Weather

In the middle of the 20th century, New Mexico was subject to extremes of weather. The year 1941, for example, was the wettest year in New Mexico's recorded history. Throughout the state, floods destroyed property and drowned lands. So much damage was done by the 1941 floods that the federal government responded with Flood Control Acts in 1946, 1948, and 1950. These acts increased the federal budget and authority for flood control projects, opening the way for large physical infrastructure projects to channel streams.

In the 1950s, by contrast, New Mexico suffered prolonged drought. This drought brought about a variety of changes in water use, law, and infrastructure. For example, groundwater pumping in New Mexico greatly increased, coinciding with improvements in pumping technology that enabled deeper and more efficient wells. In 1957, the legislature passed the Watershed District Act, which allowed for the creation of soil and water conservation districts. *See* NMSA 73-20-1 *et seq.* New storage facilities were built in New Mexico, in tandem with the authorities in the Flood Control Acts. *E.g.,* Abiquiu dam (1956), Cochiti dam (1965).

In this spirit of technological solutions, planning began for a project that would take New Mexico's share of the Colorado River through mountain tunnels for use in New Mexico's most populated corridor along the Rio Grande. This became the San Juan-Chama Project. *See* Colorado River Storage Project Act of 1956, 43 U.S.C. §620. San Juan-Chama Project construction began in 1964 and was completed in 1976.

8. Administering Groundwater and Surface Water Together

8.1 Filling in a Loophole—the 1931 Groundwater Code

For the first few decades after the passage of the New Mexico 1907 Water Code, New Mexico statutes applied only to surface water. In 1931, a new groundwater code was enacted. That 1931 enactment, which forms the basis of what is presently Article 12 of NMSA Chap. 72 (Water Laws), stated that "[t]he waters of underground streams, channels, artesian basins, reservoirs or lakes, having reasonably ascertainable boundaries, are hereby declared to be public waters and to belong to the public and to be subject to appropriation for beneficial use." *See* NMSA §72-12-1. NMSA §72-12-3 then lays out the application procedures to be followed before the State Engineer to obtain a permit for the use of underground water; those procedures track closely those of the surface water code.

Nothing in the groundwater code, however, provided any guidance on how it would be determined that a groundwater basin had "reasonably ascertainable boundaries," the trigger for State Engineer jurisdiction. In response, the State Engineer developed an administrative procedure in order to bridge this gap. The State Engineer determined the boundaries of several groundwater basins deemed by him to require administration and "declared" those basins, creating conditions and rules as appropriate. *See* Clark, Water in New Mexico, p. 298.

During the Depression and the World War II years, this procedure went unchallenged; however, increasing groundwater use as a result of drought and advances in pumping technology made it inevitable that the State Engineer's assertion of jurisdiction would be the subject of controversy. The NMSC heard a challenge to the State Engineer's authority to declare groundwater basins in *State ex rel. Bliss v. Dority*, 55 N.M. 12, 18; 225 P.2d 1007, 1013 (1950).

In its analysis, the NMSC cited the same kinds of considerations for the need for centralized administrative authority and technical expertise regarding water resources that had informed the1907 Water Code. The NMSC declared that prosperity in the West depended upon "a complete adherence to the rule of appropriation for a beneficial use as the exclusive criterion of the right to the use of water." *See Bliss* at 25*, quoting California-Oregon Power Co. v. Beaver Portland Cement Co.*, 295 U.S. 142, 157 (1935).

If New Mexico was to grow, the prior appropriation system had to work, which meant that there could be no loopholes. All water uses had to be included within the prior appropriation system, and the State Engineer needed to have all those water uses under his supervision. The *Bliss* court ruled in favor of the State Engineer and upheld the State Engineer's authority to regulate groundwater.

8.2 Assertion of the Hydrologic Connection—City of Albuquerque v. Reynolds

Once the procedure for asserting State Engineer jurisdiction over groundwater basins was in place and had survived initial challenges, the State Engineer engaged in another administrative initiative that had even more far-reaching consequences. In *City of Albuquerque v. Reynolds*, 71 N.M. 428; 379 P.2d 73 (1963), the NMSC upheld the State Engineer's authority to manage surface water and groundwater conjunctively.

This ruling meant that someone applying to appropriate groundwater under the groundwater code would be held responsible for the effects of the proposed appropriation on surface water rights. The City of Albuquerque, for example, which had been relying on groundwater wells to supply municipal needs, was required to accept permit conditions imposed by the State Engineer to protect senior surface water rights from being harmed by the effects of the city's groundwater pumping.

The State Engineer's discretionary decision to impose conjunctive management of surface and groundwater in the Rio Grande was a radical move. It was rooted in the State Engineer's technical expertise and driven by a practical need: The State Engineer must have the power to administer water in a way that reflects the scientific, hydrologic reality that surface water and groundwater are connected.

Through this action by the State Engineer, New Mexico became a leader in the West in recognizing the need for conjunctive management, to which most states now subscribe. *See* Tarlock, Law of Water Rights and Resources, 6.06 [2] ("New Mexico has a long and strong tradition of the coordination of ground and surface water rights . . . The Rio Grande protection decision [*City of Albuquerque*] is especially important and far-reaching because it sustained the power of an administrative official to use a long-time horizon in measuring the impact of groundwater pumping on surface flows").

9. Advancing Adjudications

Water rights adjudications were a new idea when the 1907 Water Code was passed. They turned out to be difficult to accomplish. Although a few adjudications were completed in the early part of the 20th century, *e.g. United States v. Hope Community Ditch*, Cause No. 712 (Equity) (D.N.M.1933), others were begun but not completed. *E.g. Snow v. Abalos*, 18 N.M. 681 (the first effort to adjudicate the Lower Rio Grande). The cases were found to be unwieldy and expensive. As a practical matter, New Mexico's water continued to be administered through various water districts or by acequias.

9.1 Increased Need for Adjudication

In middle of the 20th century there was a renewed push to adjudicate New Mexico's water rights. One driver of that movement was a federal law known as the McCarran Amendment, 43 U.S.C. 666 (1952), which waived the sovereign immunity of the United States in both state and federal court water adjudications. Prior to the McCarran Amendment, the federal government could avoid participating in a water rights adjudication under a claim of sovereign immunity. Because the federal government can make claims to large amounts of water, both in its own right and as trustees of the water rights of Native American tribes, an adjudication that did not have the United States as party would be limited in scope. Following the passage of the McCarran Amendment, many of the water rights adjudication lawsuits that are presently ongoing were filed so that the water right claims of Native American tribes could be addressed.

Another driver of the renewed effort to adjudicate was a consequence of planning for the San Juan-Chama Project. This project introduced a new source of water into the upper reaches of the Rio Grande. This water needed to be carefully accounted for and calculated separately from the water rights that already existed on the northern Rio Grande and its tributaries. Thus, many New Mexico adjudications were filed while the San Juan-Chama Project was under construction, between 1964 and 1976. For example, the Nambe-Pojoaque-Tesuque adjudication (the *Aamodt* adjudication) was filed in 1966, and the Chama and Taos/Hondo adjudications were filed in 1969.

In the southwestern part of the state, the Rio Mimbres adjudication was originally filed as a private case in 1966, but the State Engineer intervened in 1970 to transform it into an official State adjudication. *See Mimbres Valley Irrigation Co. v. Salopek*, 1977-NMSC-039, 90 N.M. 410, 564 P.2d 615. It was in the Mimbres adjudication that the USSC determined the proper measure for federal water rights on non-Native American federal reservations of land, in that case a national forest. *See United States v. New Mexico*, 438 U.S. 696 (1978). Adjudications have been the forum for many such far-reaching judicial determinations on water law. Figure 2 below depicts completed and active water rights adjudications as of 2018.

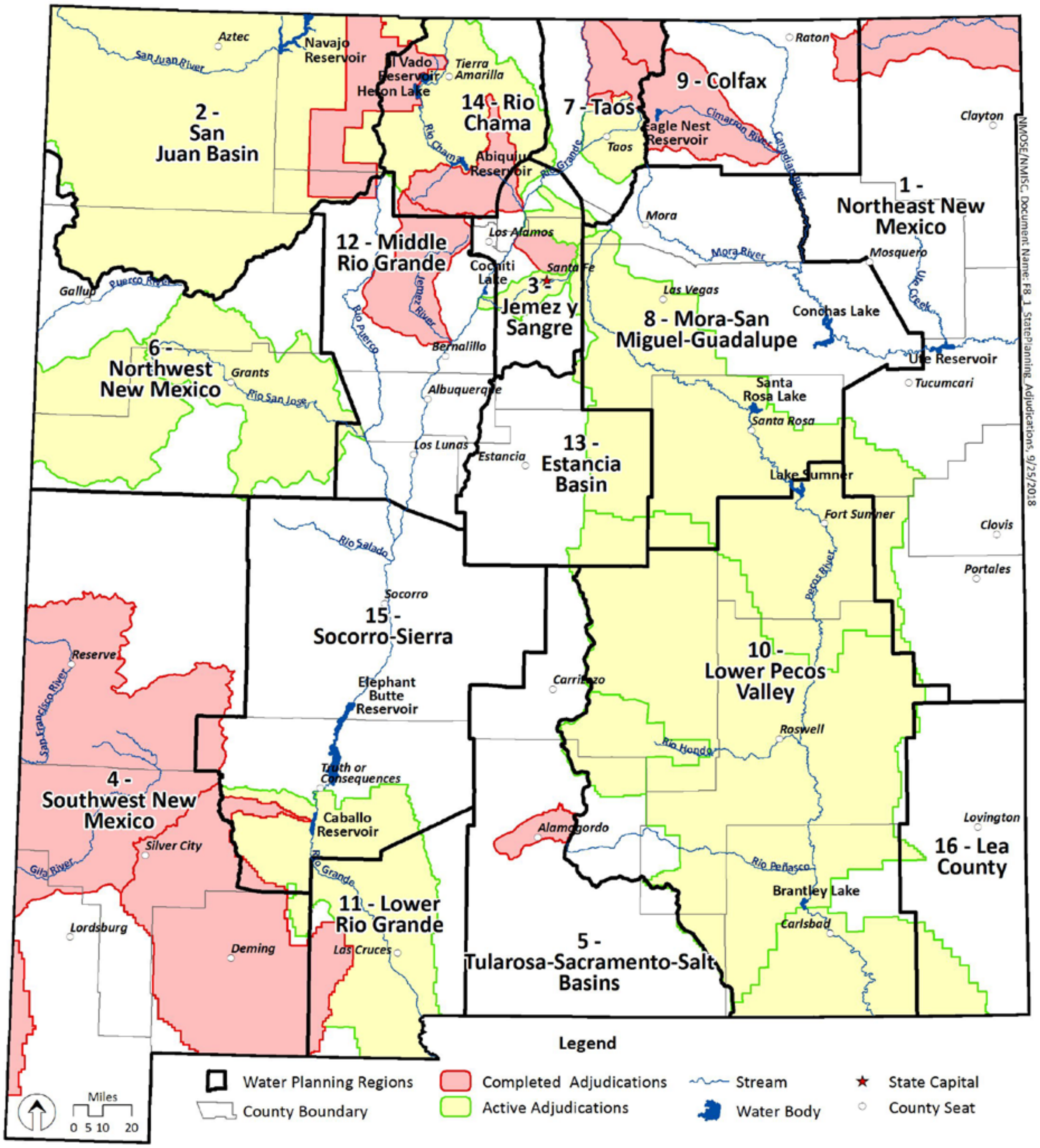

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Figure 2. Completed and Active Adjudications in New Mexico, 2018.

9.2 Active Water Resources Management

Adjudications are complicated matters that must proceed slowly, as it is important to make sure that permanent, judicial determinations of water rights are accurate, and that all parties interested have a full chance to be heard on each water right. In the face of this need for careful, deliberate, and inevitably time-consuming processes, the New Mexico legislature noted in 2003 that water administration was too urgent a matter to wait until adjudications were finished.

In NMSA §72-2-9.1, the legislature directed the State Engineer to promulgate regulations for how the State Engineer would administer water in accordance with the two fundamental principles of New Mexico water law—priority of appropriation and beneficial use—whether or not an adjudication in the area to be administered had been completed.

In response, the State Engineer promulgated the Active Water Resources Management (AWRM) regulations. *See* 19.25.13.1 *et seq.* NMAC. The regulations were challenged in court on the grounds, among others, that priority administration could not take place before the completion of an adjudication. The NMSC rejected the challenges and upheld the regulations. *See Tri-State Generation & Transmission Ass'n v. D'Antonio*, 2012-NMSC-039, 289 P.3d 1232.

The NMSC ruling effectively recognizes that, while adjudications are essential for determining the legal elements of water rights, these judicial determinations are not a precondition for the administration of water. The NMSC's recognition of a longstanding practical separation of administrative and judicial functions in New Mexico law allows, as the legislature intended, for the urgent issue of water administration to be addressed under the State Engineer's administrative authority while adjudications proceed at the pace necessary for the courts to make permanent judicial determinations of water rights.

In addition, the AWRM regulations allow for flexible arrangements for water rights administration. The AWRM regulations are framework regulations that allow the State Engineer to promulgate district-specific regulations for particular water master districts in the state, allowing for the unique circumstances of each district to be accommodated. *See* 19.25.13.6 NMAC. The AWRM regulations also allow water user groups to be formed to propose ideas for alternative administration that, provided there is agreement within the district and approval by the State Engineer, may be used for administration. *See* 19.25.13.38 NMAC. District specific regulations under AWRM were promulgated for the Nambe-Pojoaque-Tesuque Water Master District on September 17, 2017. District-specific regulations are in development in other areas of the state.

Over time, water rights adjudications have gradually taken their proper place as the judicial undertakings that support the overarching goal of comprehensive administration of New Mexico's water resources.

10. Quantifying Native American Water Rights

With 24 recognized Native American nations, tribes, and pueblos, New Mexico is unique in the strong presence and diversity of its Native American population. New Mexico works with nations, tribes, and pueblos to ensure that Native American water rights are determined and administered under appropriate laws.

10.1 Federal Law Theories of the Quantification of Native American Water Rights

The adjudication courts apply different legal standards to the determination of Native American water rights. For nations, tribes, and pueblos which have a federal reservation of land, the adjudication court applies the doctrine of federally reserved water rights. Under this doctrine, established by the USSC in *Winters v. United States,* 207 U.S. 564 (1908) actual beneficial use—so fundamental to State law—is not the basis of the water right.

Instead, the adjudication court looks to the intent of Congress in making the reservation and implies a reservation of water in the amount necessary to fulfill that purpose, regardless of actual beneficial use. The priority date relates to the date the United States created the reservation. *E.g., Arizona v. California*, 460 U.S. 605 (1983) (holding that the quantification of Native American water rights can be based on the standard of "practicably irrigable acreage"; that is, enough water to irrigate however much of the reservation can be irrigated as a practical matter, whether or not there has ever been actual irrigation on those lands); *State of N.M. ex rel. State Engineer v. Comm' r of Pub. Lands,* 2009-NMCA-004.

For nations, tribes, and pueblos, the laws that apply to determine water rights which are not based upon a federal reservation is still a subject for litigation in the court, making the adjudication even more time-consuming and expensive in requiring the development of both law and facts.

10.2 Native American Water Rights Settlements

The United States, New Mexico, and seven nations, tribes, and pueblos have successfully negotiated four separate settlements of Native American water rights which have been approved by Congress:

- The Jicarilla Apache Tribe Water Rights Settlement Act of 1992, Pub. L. No. 102-441, 106 Stat. 2237, as amended, Pub. L. No. 104-261, 110 Stat. 3176 (1996), as amended, Pub. L. 105-256, 12 Stat. 1896 (1998);
- The Northwestern New Mexico Rural Water Projects Act (Navajo San Juan Settlement), Pub.L.No. 111-11, Part X, Subtitle B, 123 Stat. 991 (2009);
- The Taos Pueblo Indian Water Rights Settlement Act of 2010, Pub. L. No. 111-291, title V, 124 Stat. 3064, 3122; and
- The Aamodt Litigation Settlement Act of 2010 (Pueblos of Nambe, Pojoaque, San Ildefonso, and Tesuque), Pub. L. No. 111-291, title VI, 124 Stat. 3064, 3133.

Such settlements offer an alternative to decades of litigation over issues of Native American water rights adjudication. Further, such settlements allow local governments and water rights owners to develop regional solutions with the nations, tribes, and pueblos that promote finality and certainty about water.

10.3 Consultation with Nations, Tribes, and Pueblos

The nations, tribes, and pueblos in New Mexico are sovereign governments that assert authority and responsibility over water use and water quality within their territories. The nations, tribes, and pueblos in New Mexico highly value water and are deeply connected to their water though ancient custom and traditions that are passed from generation to generation. The State of New Mexico recognizes the importance of passing on such sacred values and will respect traditional, cultural, and religious values and uses of water of nations, tribes, and pueblos in the planning process and in the government-to-government consultation described below.

The State respects the water management, laws, policies, and practices of each of the Native American nations, tribes, and pueblos and commits, in accordance with NMSA §72-14.3.1(E)(1), to work cooperatively with each nation, tribe, and pueblo on a government-to-government basis on water planning matters. The OSE (Office of the State Engineer) in collaboration with the ISC was honored to engage in such consultations with regard to the present State Water Plan. On May 17, 2017, for example, the OSE in collaboration with the ISC, held a State Tribal Water Institute in order to provide information to the nations, tribes, and pueblos and invite their concerns and comments. The State Engineer, as well as representatives of the Water Planning Program of the ISC, have met with Governors, tribal council members, and staff of nations, tribes, and pueblos to discuss a variety of matters, including this *2018 New Mexico State Water Plan.*

Nations, tribes, and pueblos in New Mexico assert aboriginal, time immemorial, and/or federal reserved water rights to both surface water and groundwater necessary to ensure a permanent homeland for future generations, which they further assert are not subject to forfeiture or abandonment. The nations, tribes, and pueblos also assert that these rights encompass both water quality and quantity, which are inseparable and require the protection of watershed environments. Some nations, tribes, and pueblos also assert storage rights, contract water rights, and/or State law-based water rights. The State acknowledges that the nations, tribes, and pueblos will assert these rights throughout the water planning process. The State will continue its practice of consulting in good faith on these matters on a government-to-government basis.

In accordance with NMSA §72-14-3.1(J), the State planning process will not limit the water claims of nations, tribes, or pueblos. It is understood that there are other processes that must occur before Native American water claims can be finalized, and conflicting needs will need to be considered. For example, members of some nations, tribes, or pueblos may not want to share information about future water needs before their claims are resolved. The OSE in collaboration with the ISC looks forward to ongoing, meaningful consultation on water matters with the nations, tribes, and pueblos of New Mexico to be sure all water users are considered in the interest of statewide planning.

11. Implementing Environmental Laws and Regulations

In the late 1960s and early 1970s, Congress passed a variety of environmental laws, including the Endangered Species Act (ESA), 15 U.S.C. §1531 *et seq*., and the Clean Water Act (CWA), 33 U.S.C. §1251 *et seq.* Environmental laws add different issues to traditional water law. In litigation under the ESA, for example, arguments have been offered that the beneficial use of water includes uses to support endangered species of fish or birds and that instream flows must be considered for these purposes.

There have been several ESA situations in New Mexico that have raised the question of possible changes to established water administration practices in order to protect endangered species. In *Rio Grande Silvery Minnow v. Keys*, 355 F.3d 1215 (10th Cir. N.M., 2004) and related cases, environmental groups sued to have Reclamation time and quantify its releases of water in such a way as to protect the endangered Rio Grande Silvery Minnow, one of the last native fishes remaining in the Rio Grande. Similarly, the Pecos Bluntnose Shiner, also an endangered species of fish, has caused re-consideration of how dams are operated on the Pecos River. *See* www.ose.state.nm.us/Basins/Pecos/isc_pecos_nepa.php (describing alternative operations proposals under the National Environmental Policy Act [NEPA], 42 U.S.C. §4321 *et seq.*).

The CWA also suggests some possible new issues. In the 1907 Water Code, the law addressed *quantity* questions for the appropriation of water—how can New Mexico properly distribute a scarce resource? The CWA requires water administrators to look at water *quality*—is the water clean enough for use? Bringing these two ways of thinking about water closer together is likely to be an important challenge for the future. New Mexico has sought to meet that challenge through, for example, the Water Quality Act (WQA), NMSA §74-6-1 *et seq*. The WQA creates the Water Quality Control Commission.

The State Engineer, so central to every aspect of water quantity, sits on the Water Quality Control Commission (or the State Engineer's designee), among other agency heads. *See* NMSA 1978 §74-6-3. The Water Quality Control Commission is charged with creating a "comprehensive water quality management program," as well as determining water quality standards and supporting the continuing planning process. *See* NMSA 1978 §74-6-4.

The ESA and the CWA are only two examples of the way that the rise and increasing importance of environmentalism poses new questions for the administration of water in New Mexico. These new questions must be considered in the context of the long development of New Mexico water law. In turn, they join all of the landmark events and circumstances that render this field of law so important and complex.

The 1907 Water Code, acequias and special districts, the negotiation of interstate compacts, building infrastructure to prepare for floods and droughts, the integration of groundwater into water administration, the push for adjudications, and the rise of environmental considerations are each and all part of the need for comprehensive state water planning that can provide New Mexico with guidance for its water future.

12. Considering the El Paso Case and Public Welfare

New Mexico's water planning statutes are themselves a landmark event in the development of New Mexico water law. Water planning, as the population increases, would undoubtedly have become a critical feature of water policy under any circumstances. As it happened, however, New Mexico's water planning statutes are a consequence of a particular chain of circumstances that began with the USSC case of *Sporhase v. Nebraska*, 458 U.S. 941, 102 S. Ct. 3456, 73 L. Ed. 2d 1254 (1982). In that case, the USSC ruled that water is an article of interstate commerce, so that it was unconstitutional for states to forbid the export of water across state lines.

Before that ruling, most states in the West, including New Mexico, had statutes that forbade the export of water from the state. In 1983, the City of El Paso, Texas, which wished to obtain groundwater rights in New Mexico for use in Texas, sued to have New Mexico's anti-export statute declared unconstitutional under *Sporhase*, and won. *See El Paso by Pub. Serv. Bd. v. Reynolds*, 563 F. Supp. 379 (D.N.M. 1983).

New Mexico enacted a statute in 1983, NMSA §72-12B-1, which allows the export of water from the state, provided that the State Engineer finds that the export "would not impair existing water rights, is not contrary to the conservation of water within the state and is not otherwise detrimental to the public welfare of the citizens of New Mexico." *Id.* at (C).

Roughly simultaneously, this language requiring the State Engineer to consider the public welfare and the conservation of water within the state was added to many provisions of the 1907 Water Code. *E.g.* NMSA §72-5-7 (basis for the State Engineer to grant a surface water permit). In 1985, New Mexico also enacted NMSA §72-1-9, which codified a longstanding principle of law that, because of a need to plan for growth and future use, certain public institutions, including municipalities, were allowed a longer period than other entities within which to place water to beneficial use under a State Engineer permit. *See State ex rel. State Eng'r v. Crider*, 78 N.M. 312, 431 P.2d 45 (1967). The new statute recognized an existing State Engineer administrative policy of capping the grace period at 40 years, effectively allowed for a planning period of 40 years. *See* NMSA §72-1-9 (A).

These standards regarding public welfare and conservation, as well as a 40-year planning period, were applied to the applications of the City of El Paso, Texas to appropriate groundwater in New Mexico. El Paso was unable to prove that it could put the water to use within 40 years and its applications were denied.

13. Improving Statewide Water Planning

The changes to New Mexico's statutes made in connection with the shift in water law brought on by *Sporhase* have had long-term effects, especially for water planning. NMSA 72-12B-1(D) states that, among other factors that are relevant to the question of whether a particular application to export water is consistent with the public welfare, the State Engineer must consider:

(1) the supply of water available to the state of New Mexico;
(2) water demands of the state of New Mexico;
(3) whether there are water shortages within the state of New Mexico;

The need to have this information available gave rise to New Mexico's regional water planning program, funded by a 1987 statute, NMSA §72-14-44, which provided funding to the ISC for such a program.

Regional water planning developed over time. *Part II: Technical Report,* Section 2.1 includes more information about the history of regional water planning; also see John R. Brown: "*Whisky's fer Drinkin'; Water's fer Fightin'!" Is It? Resolving a Collective Action Dilemma in New Mexico*, 43 Nat. Resources J. 185, 190-200 (2003) (giving a description of the development of the regional water planning program). The process of regional water planning was aided in 1994 with the creation of the ISC Regional Water Planning Handbook (revised in 2013) (2013 Handbook).

The 2013 Handbook's template, containing elements to be included in all regional water plans, allowed the plans to be compared with each other and also allowed for a common vocabulary and common standards to evolve. Perhaps even more importantly, the 2013 Handbook explicitly adopted the principle that it was essential in water planning to have public participation—it should not be just a matter of consulting experts. Brown, *supra*, at 198 ("The idea that public participation is essential, not only to local legitimacy but to a proper understanding of public welfare . . . became no longer simply a working assumption of regional planners, but an accepted tenet of state water policy").

In 2003, the New Mexico legislature enacted NMSA §72-14-3.1, which directs the ISC, in collaboration with the Office of the State Engineer and the Water Trust Board, to prepare and implement a comprehensive State Water Plan. This *2018 New Mexico State Water Plan* builds on the work of the regional water plans, integrating them as consistent with state water plan policies and strategies. *Id.,* at (C) (11).

Public participation and input remain integral parts of the State Water Plan. *Id.,* at (F). *Part I: Policies* incorporates information gained from the State Water Plan Town Hall, a two-day event held for the public on December 13 and 14, 2017. In addition to holding a public town hall event, the ISC also released the Draft State Water Plan on the OSE and ISC website for public comment from July 9, 2018, until August 25, 2018. All comments received were considered and many resulted in change or development of this document.

New Mexico water planners and other stakeholders are continuously working toward a more comprehensive approach to water planning. Increasing public knowledge of relevant water laws and codes that apply to New Mexico will contribute to better public participation in water use and planning decisions and help shape the future for the next generation of water users. *Part II: Technical Report* represents the culmination of many of these legal landmarks and the continued efforts of the State of New Mexico to plan comprehensibly for regional and statewide water use in the present and into the future.

Report on determining the draft objective of the 2018 New Mexico State Water Plan

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Determining the objective of the 2018 State Water Plan is imperative to the development of the State Water Plan Charter and State Water Plan. Information related to the objectives and priorities of the State Water Plan Act, 2003 New Mexico State Water Plan, 2008 State Water Plan Review and Proposed Update, and State Water Plan 2013 Review are briefly summarized below to help provide context and parameters for the 2018 State Water Plan. Common issues identified during the 2016 Regional Water Planning process were also included in this analysis. We have attempted to consolidate and update the priorities or issues of these State and Regional Water Plan documents in order to provide a consistent foundation for the 2018 and future updates.

This report recommends continuing to use the purposes mandated in the State Water Plan Act as the objective for the 2018 State Water Plan. The report also includes additional draft recommendations for Planning Priorities for the 2018 State Water Plan.

We first provide a preliminary comment on the semantics of planning terminology used in past State Water Planning documents.

The State Water Plan Act states the *Purposes* of the Plan.

The 2003 State Water Plan sets forth its *Priorities, Goals,* and *Objectives.*

The 2008 State Water Pan Update reviewed the success of the 2003 State Water Plan, the progress made since 2003, and what conditions had changed since 2003. It did not add any new planning terminology.

The 2013 State Water Plan Review was cast as a summary of the current status of water management and a review of the 2003 State Water Plan *Directives* (although this term is not used in the 2003 State Water Plan).

The terms *purposes*, *priorities*, *goals*, *objectives*, and *directives* seem to be interchangeable in these documents. We have now been charged with identifying the *objective* of the 2018 State Water Plan Update.

It may be useful to review the plain definitions of these terms.
Directives refer to official instructions.
Purposes and *objectives* both refer to the reason why something is done.
Goals are desired results. Reaching *goals* helps one to achieve their *purposes* and *objectives.*

Priorities refer to what is most important. Prioritizing goals helps one achieve their purposes and objectives efficiently.

We are deriving our *objective* from the *directives* in the State Water Planning Act. The primary *directives* for the Interstate Stream Commission are to the create and regularly update a State Water Plan that shall not be construed as granting or condemning water rights or affecting Indian water rights.[1]

The State Water Planning Act also provides specific *goals* for the State Water Plan process. This includes collaborative development of a State Water Plan that includes work plans and strategies for some specific *goals*. [2]

The State Water Plan Act does not set forth *priorities*.

Because the terms *purpose* and *objective* have the same meaning, we suggest the Interstate Stream Commission base the 2018 Update *objective* on the *purposes* explicitly set forth in the State Water Planning Act.

Proposed Objective

The objective of the State Water Plan, per the Legislature's directive, [3] is to implement a strategic management tool for the following purposes:

(1) Promoting stewardship of the state's water resources;
(2) Protecting and maintaining water rights and their priority status;
(3) Protecting the diverse customs, culture, environment and economic stability of the state;
(4) Protecting both the water supply and the water quality;
(5) Promoting cooperative strategies, based on concern for meeting the basic needs of all New Mexicans;
(6) Meeting the state's interstate compact obligations;
(7) Providing a basis for prioritizing infrastructure investment; and,
(8) Providing statewide continuity of policy and management relative to our water resources.

Priorities

In an effort to help the Interstate Stream Commission determine its 2018 State Water Plan priorities, we reviewed the 2003 State Water Plan, the 2008 and 2013 State Water Plan Reviews, and the recently completed Regional Water Plans to identify past and current priorities and issues. Our intent was to create a common foundation of priorities for future planning updates.

[1] §72-14-3.1(A),(I)&(J).
[2] §72-14-3.1(D).
[3] §72-14-3.1(B).

2003 State Water Plan

The 2003 State Water Plan begins by explicitly setting forth its "Common Priorities, Goals and Objectives." It did not distinguish between what on the list was considered to be a priority, a goal, or an objective. They are all set forth here with reference to the State Water Plan's stated objectives.[4]

Ensuring that water is available for the continued and future economic vitality of the State;

- This is related to objectives (1), (3), (4) & (6).

Ensuring a safe and adequate drinking water supply for all New Mexicans;

- This is related to objective (4).

Developing water resources to expand the available supply;

- This might be related to objectives (1) & (4) but seems to be a new addition. This item is somewhat ambiguous and may be controversial. The 2013 SWP Review says that there is "little" to "no" new surface water and groundwater supplies are very limited. It emphasizes that there is an opportunity to develop methodologies and tools to estimate the longevity of water supplies around the state.

Promoting conservation and the efficient use of water;

- This is related to objective (1).

Promoting drought planning;

- This is related to objectives (1), (4), (5) & (8).

Protecting, maintaining, and enhancing the quality of the State's waters;

- This is related to objective (4).

Providing for fish and wildlife habitat preservation and maintenance and for river restoration;

- This is related to objective (3).

Protecting senior water rights;

- This is related to objective (2).

Maintaining and enforcing interstate stream compact compliance;

- This is related to objective (6).

Preserving state administrative authority over the State's waters; and

- This is related to objective (8).

Completing water rights adjudications.

- This is related to objective (2).

[4] *Id.*

2008 State Water Plan Review and Proposed Update

In 2008 the Interstate Stream Commission produced a Review and Proposed Update for the State Water Plan. Although not an actual update, the document did review progress made on some, but not all, of the purposes and priorities identified in the 2003 State Water Plan. It also listed, in no particular order, priorities for the Proposed Update. They are all set forth here with reference to the State Water Plan's stated objectives.

Emphasize conservation;
- This is related to objective (1).

Recognize impacts of the energy / water nexus;
- This is related to objectives (1) & (5).

Implementation of Active Water Resource Management;
- This is related to objectives (1), (2), (4), (6) & (8).

Progress in licensing or adjudicating of water rights;
- This is related to objective (2).

Integrate, revise, and improve water budgets;
- This is related to objectives (1), (4), (6), (7) & (8).

Improve understanding of water supply and demand;
- This is related to objectives (1), (4), (6), (7) & (8).

Define consistent terms and standards for water budgets;
- This is related to objectives (1), (4), (7) & (8).

Critical infrastructure needs, including information necessary to prioritize;
- This is related to objectives (1), (4), (6), (7) & (8).

Water settlements;
- This is related to objectives (1) & (2).

Detailed State Water Plan Implementation schedule including responsibilities, schedules and costs;
- This is related to objectives (1), (4), (6), (7) & (8).

Impact of climate change on water resources;
- This is related to objectives (1), (3), (4), (6) & (7).

Water quality
- This is related to objective (4).

2013 State Water Plan Review

In 2013 the Interstate Stream Commission prepared another State Water Plan Review. Like the 2008 Review, this document was not an actual update. It proposed updating the State Water Plan by the end of 2015 and provided a detailed review of progress made on a number of water management issues. The 2013 Review focuses on infrastructure and extreme precipitation events by emphasizing "the infrastructure required to incentivize economic growth in our water planning regions and to insulate the economy from extreme precipitation events."

The description of the water management issues were not categorized according to the objectives of the State Water Plan Act, but rather in accord with a limited number of the goals set forth in the Act. They are all set forth here with reference to the State Water Plan's stated objectives.

Extreme Precipitation Events: Planning for Droughts and Floods
- This is related to objectives (1), (7) & (8).

Active Water Resource Management
- This is related to objectives (1), (2), (4), (6, & (8).

Developing Water Sources
- This is related to objectives (1) & (4).

Preserving Water Quality
- This is related to objective (4).

Water Rights Adjudications
- This is related to objective (2).

Indian Water Rights Settlements
- This is related to objectives (1) & (2).

Endangered Species
- This is related to objectives (1), (3),& (4).

Water Use and Conservation
- This is related to objectives (1) & (4).

Water Infrastructure and Management
- This is related to objective (7).

Planning for New Mexico's Water Demand
- This is related to objectives (1), (4), (6), (7), & (8).

2016 Regional Water Plans

One outcome of the 2016 Regional Water Planning process was the identification of Key Collaborative Strategies that reinforced some of the 2003 and 2013 State Water Plan Reviews' priorities. These strategies continue to be analyzed and are subject to refinement. Newly identified Key Collaborative Strategies represented in many of the Regional Water Plans include:

Protecting forest and watershed health; (Identified in 14 of 16 RWPs)
- This is related to objectives (1), (3), (4) & (7).

Water and waste water infrastructure management;(Identified in 13 of 16 RWPs)
- This is related to objectives (1), (4), (6) & (7).

Flood and hazard mitigation planning (to be resilient under climate change) (Identified in 6 of 16 RWPs) and,
- This is related to objective (1), (3), (4), (6), (7) & (8).

Improve understanding of resources. (Suggestions related to this topic identified in almost all RWPs)
- This is related to objectives (1), (3), (4), (6), (7) & (8).

Integrated Historic and Current Priorities

In order to see a full picture of what the past state water and regional planning documents have considered priorities, the priorities identified above have been nested below within the objectives mandated in the State Water Plan Act to which they are most closely related. Recognizing that many of these priorities pertain to more than one element of the proposed objective, we attempted to identify under which objective each priority fell most directly. This consolidated list of priorities reflects the most current evolution of New Mexico's water planning priorities.

(1) Promoting stewardship of the state's water resources.
- Ensuring that water is available for the continued and future economic vitality of the State;
- Promoting conservation and the efficient use of water;
- Promoting drought planning;
- Improve understanding of resources; and,
- Recognize impacts of the energy / water nexus.

(2) Protecting and maintaining water rights and their priority status.
- Protecting senior water rights;
- Progressing in licensing of water rights; and,
- Completing water rights adjudications and water settlements (including Indian water rights).

(3) Protecting the diverse customs, culture, environment and economic stability of the state.
- Providing for fish and wildlife habitat preservation and maintenance and for river restoration, including endangered species;
- Protecting forest and watershed health;

- Flood and hazard mitigation planning; and,
- Improve understanding of resources.

(4) Protecting both the water supply and the water quality.
- Ensuring a safe and adequate drinking water supply for all New Mexicans;
- Protecting, maintaining, and enhancing the quality of the State's waters;
- Understanding the impact of climate change on water resources; and,
- Protecting forest and watershed health.

(5) Promoting cooperative strategies, based on concern for meeting the basic needs of all New Mexicans.
- No priorities from past State Water Planning efforts fell directly under this objective.

(6) Meeting the state's interstate compact obligations.
- Maintaining and enforcing interstate stream compact compliance.

(7) Providing a basis for prioritizing infrastructure investment.
- Water and waste water infrastructure management;
- Critical infrastructure needs, including information necessary to prioritize; and,
- Planning for extreme precipitation events (droughts and floods).

(8) Providing statewide continuity of policy and management relative to our water resources.
- Preserving state administrative authority over the State's waters;
- Implementation of Active Water Resource Management;
- Integrate, revise, and improve water budgets;
- Improve understanding of water supply and demand;
- Define consistent terms and standards for water budgets; and,
- Detailed State Water Plan Implementation schedule including responsibilities, schedules and costs.

Draft Recommendations for Planning Priorities for the 2018 State Water Plan

In reviewing the objectives in the State Water Plan Act, we looked through the lens of what does this mean to us now? The suggested priorities identified below are nested within those objectives in the State Water Planning Act that reflect water management issues that we believe currently address changing conditions and have momentum or the opportunity to gain momentum.

Reviewing past water planning documents and the regional water plans was the foundational part of the process to identify these draft planning priorities for the 2018 State Water Plan. The suggested priorities include water management issues prioritized in the past State Water Planning documents and the Key Collaborative Strategies developed through the Regional Water Planning process.

These selected priorities are also influenced by specific historic priorities that have repeatedly been identified as priorities in past and current planning documents. The proposed priorities relate most directly to objectives 1, 6, 7, and 8 in the State Water Plan Act. (The numbers below continue to correspond with the Act's enumeration for reference.)

These proposed priorities are intended to serve as a basis for consideration of water planning priorities and we anticipate will be refined based on the perspectives of Interstate Stream Commission staff.

(1) Promoting stewardship of the state's water resources.

- Ensuring that water is available for the continued and future economic vitality of the State;
- Promoting conservation and the efficient use of water;
- Promoting drought planning [also relates to (4), (5) & (8)];
- Improve understanding of resources; and
- Promoting watershed restoration.

(6) Meeting the state's interstate compact obligations.

- ISC's historic role in managing Compact compliance and the current Supreme Court litigation.

(7) Providing a basis for prioritizing infrastructure investment

- Water and waste water infrastructure management.
- Watershed planning.
- Conservation planning.

(8) Providing statewide continuity of policy and management relative to our water resources.

- Preserving state administrative authority over the State's waters.
- Strengthening process for State and Regional Water Planning.