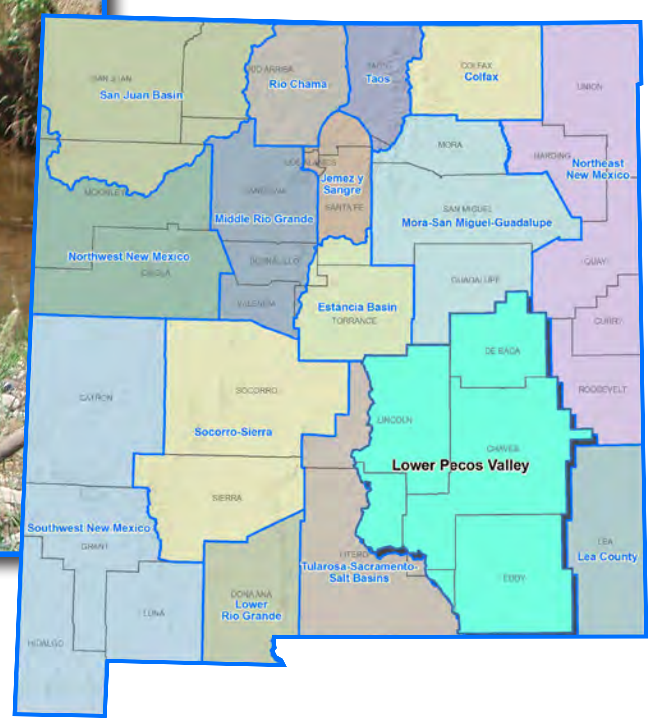
Lower Pecos Valley Regional Water Plan



December 2016

State of New Mexico
Interstate Stream Commission
Office of the State Engineer

Cover photograph: East of the Delaware River looking downstream, Eddy County, New Mexico

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Note: Appendix designations indicate corresponding section in plan

List of Acronyms

°F	degrees Fahrenheit
ac-ft/yr	acre-feet per year
AMO	Atlantic multidecadal oscillation
AWRM	Active Water Resource Management
BBER	Bureau of Business and Economic Research
BLM	Bureau of Land Management
BO	Biological Opinion
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFRP	Collaborative Forest Restoration Program
CID	Carlsbad Irrigation District
CWA	Clean Water Act
DBS&A	Daniel B. Stephens & Associates, Inc.
DWS	Domestic Well Statute
EIS	environmental impact statement
ENMU	Eastern New Mexico University
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FLETC	Federal Law Enforcement Training Center
ft amsl	feet above mean sea level
FY	fiscal year
GIS	geographic information system
gpcd	gallons per capita per day
gpm	gallons per minute
GWQB	Ground Water Quality Bureau [New Mexico Environment Department]
ICIP	Infrastructure Capital Improvement Plan
in/yr	inches per year
IPCC	Intergovernmental Panel on Climate Change
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDWCA	mutual domestic water consumers association
MSGP	Multi-Sector General Permit

NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NMAC	New Mexico Administrative Code
NMBGMR	New Mexico Bureau of Geology & Mineral Resources
NMED	New Mexico Environment Department
NMG&F	New Mexico Department of Game and Fish
NMISC	New Mexico Interstate Stream Commission
NMOSE	New Mexico Office of the State Engineer
NMSA	New Mexico Statutes Annotated
NMSU	New Mexico State University
NMWQCC	New Mexico Water Quality Control Commission
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
PCB	polychlorinated biphenyl
PDO	Pacific decadal oscillation
PDSI	Palmer Drought Severity Index
PPP	project, program, and policy
PSTB	Petroleum Storage Tank Bureau (NMED)
PVACD	Pecos Valley Artesian Conservancy District
PVWUO	Pecos Valley Water Users Organization
RWP	regional water plan
SDWA	Safe Drinking Water Act
SNOTEL	snowpack telemetry
SWCD	soil and water conservation district
TDS	total dissolved solids
TMDL	total maximum daily load
U.S. EPA	U.S. Environmental Protection Agency
UNM	University of New Mexico
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program

USGS	U.S. Geological Survey
UST	underground storage tank
UWB	underground water basin
WBP	watershed based plan
WQA	Water Quality Act (New Mexico)
WRCC	Western Regional Climate Center
WRRI	Water Resources Research Institute
WSD	water and sanitation district
WTB	Water Trust Board
WUA	water users association
WUI	wildland-urban interface
WWTP	wastewater treatment plant

Executive Summary

The Lower Pecos Valley Water Planning Region, which includes all of De Baca County and parts of Lincoln, Chaves, Otero, and Eddy counties (Figure ES-1), is one of 16 water planning regions in the State of New Mexico. Regional water planning was initiated in New Mexico in 1987, its primary purpose being to protect New Mexico water resources and to ensure that each region is prepared to meet future water demands. Between 1987 and 2008, each of the 16 planning regions, with funding and oversight from the New Mexico Interstate Stream Commission (NMISC), developed a plan to meet regional water needs over the ensuing 40 years. The Lower Pecos Valley Regional Water Plan was completed and accepted by the NMISC in 2001.

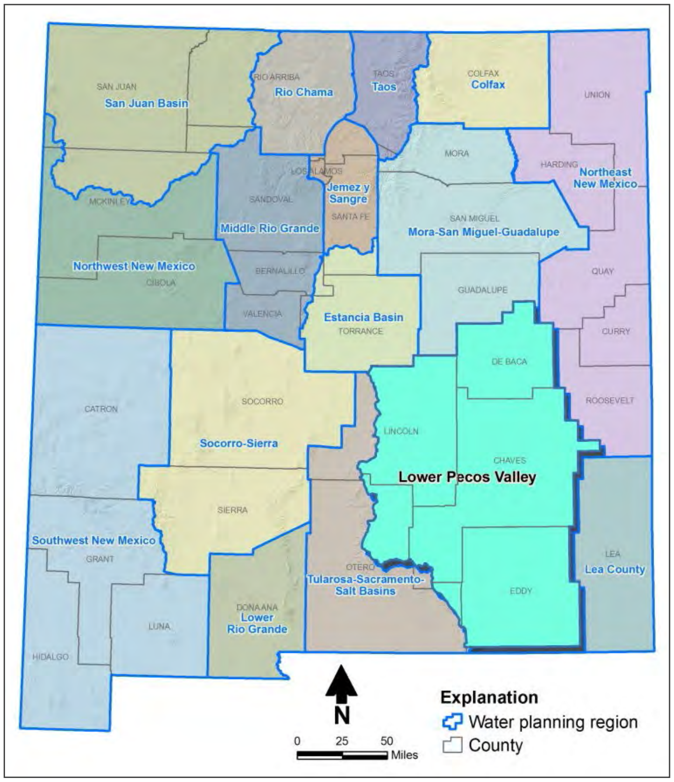


Figure ES-1. Lower Pecos Valley Water Planning Region

The purpose of this document is to provide new and changed information related to water planning in the Lower Pecos Valley region and to evaluate projections of future water supply and demand for the region using a common technical approach applied to all 16 planning regions statewide. Accordingly, this regional water plan (RWP) update summarizes key information in the 2001 plan and provides updated information regarding changed conditions and additional data that have become available.

Based on updated water use (Figure ES-2) data from 2010, Figure ES-3 illustrates the total projected regional water demand under high and low demand scenarios, and also shows the administrative water supply and the drought-adjusted water supply. The administrative water supply is based on 2010 withdrawals of water and is an estimate of future water supplies that considers both physical availability and compliance with water rights policies. Because of its reliance on surface water, the region has a high degree of vulnerability to prolonged drought, and the estimated shortage in drought years is expected to range from 94,000 to 166,000 acre-feet per year. The oil and gas industry has been growing in this region and produced water reuse is strongly supported as a strategy to deal with this gap.

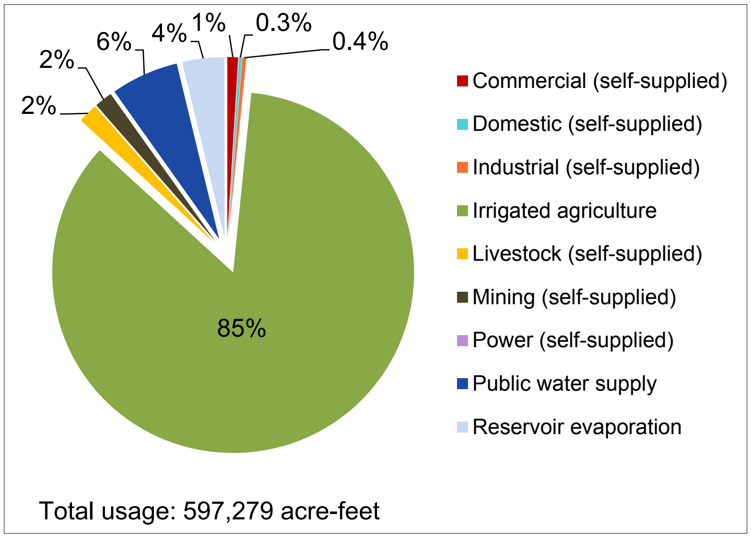


Figure ES-2. Total Regional Water Use, 2010

Note: Tribes and Pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

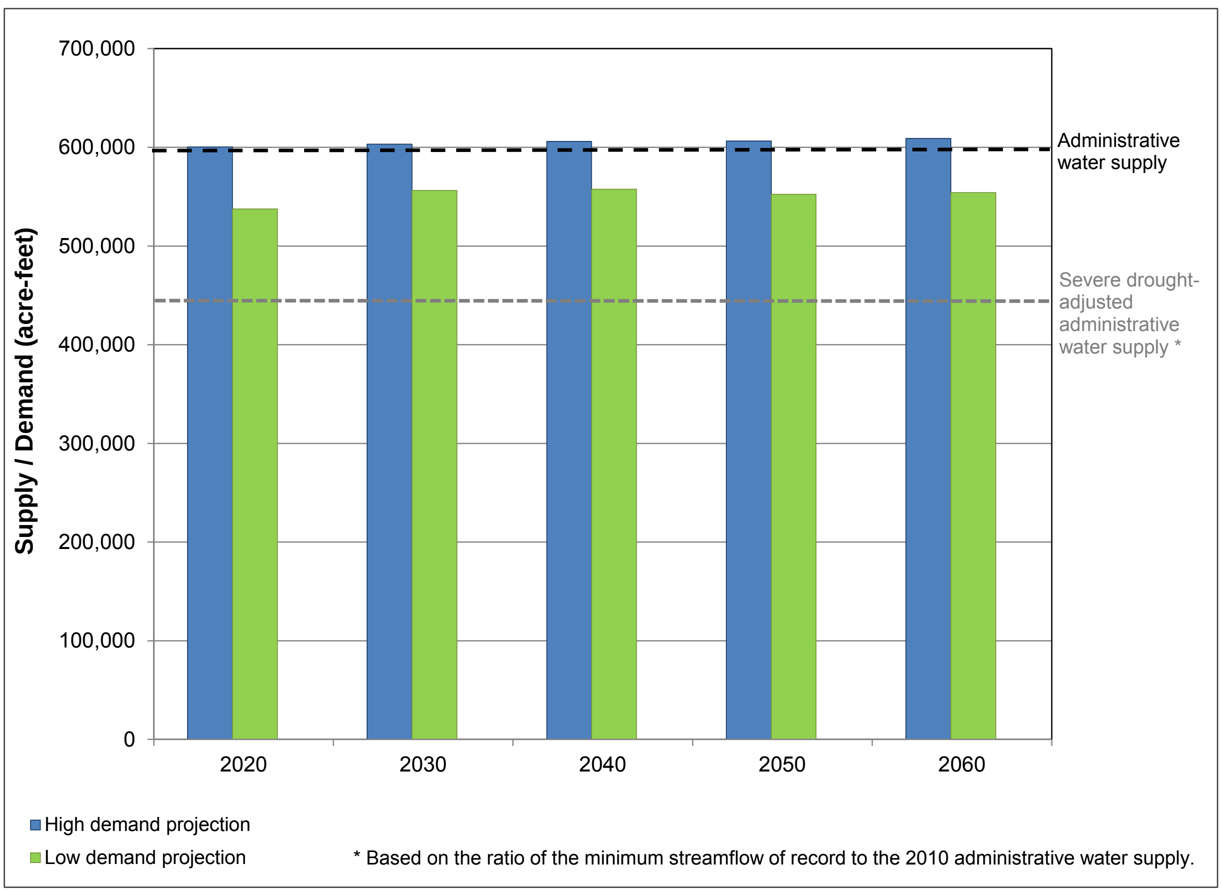


Figure ES-3. Available Supply and Projected Demand

Note: Tribes and Pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

Planning Method

For this RWP, water supply and demand information was assessed in accordance with a common technical approach, as identified in the *Updated Regional Water Planning Handbook: Guidelines to Preparing Updates to New Mexico Regional Water Plans* (where it is referred to as a common technical *platform*) (Handbook). This common technical approach outlines the basis for defining the available water supply and specifies methods for estimating future demand in all categories of water use:

- The method to estimate supply (referred to as the *administrative water supply* in the Handbook) is based on withdrawals of water as reported in the *New Mexico Water Use by Categories 2010* report prepared by the New Mexico Office of the State Engineer (NMOSE). Use of the 2010 data provides a measure of supply that considers both physical supply and legal restrictions (i.e., the water is physically available for withdrawal, and its use is in compliance with water rights policies) and thus reflects the amount of water available for use by a region.
- An estimate of supply during future droughts is also developed by adjusting the 2010 withdrawal data based on physical supplies available during historical droughts.
- Projections of future demand in nine water use categories are based on demographic and economic trends and population projections. Consistent methods and assumptions for each category of water use are applied across all planning regions.

Common Technical Approach

To prepare both the regional water plans and the state water plan, the State has developed a set of methods for assessing the available supply and projected demand that can be used consistently in all 16 planning regions in New Mexico. The objective of applying this common technical approach is to be able to efficiently develop a statewide overview of the balance between supply and demand in both normal and drought conditions, so that the State can move forward with planning and funding water projects and programs that will address the State's pressing water issues.

Public Involvement

The updated Handbook specifies that the RWP update process "shall be guided by participation of a representative group of stakeholders," referred to as the steering committee. Steering committee members provided direction for the public involvement process and relayed information about the planning effort to the water user groups they represent and other concerned or interested individuals.

In addition to the steering committee, the water planning effort included developing a master stakeholder list of organizations and individuals interested in the water planning update. This list was developed from the previous round of water planning and then expanded through efforts to identify representatives from water user groups and other stakeholders. Organizations and individuals on the master stakeholder list were sent announcements of meetings and the RWP update process and progress.

Over the two-year update process, nine meetings were held in the Lower Pecos Valley region. These meetings identified the program objectives, presented draft supply and demand calculations for discussion and to guide strategy development, and provided an opportunity for stakeholders to provide input on the strategies that they would like to see implemented. All steering committee meetings were open to the public and interested stakeholders, and participation from all meeting attendees was encouraged.

Key Water Issues

The key water supply updates and issues currently impacting the Lower Pecos Valley region include the following:

- The majority of the water use in the Pecos River Basin occurs in the lower basin—that is, from Sumner Dam to the lower end of the Carlsbad Irrigation District (CID) near the confluence of the Black and Pecos rivers. The principal constraint to use of this water is the 1948 Pecos River Compact. Over the past decade, New Mexico has made significant progress toward assuring long-term compliance with its obligations under the Compact. The New Mexico State Legislature, the NMOSE, the NMISC, and Pecos Basin water user groups continue to collaborate to address ongoing Compact and other Pecos Basin water management issues. Compact-related accomplishments include:
    - Since the U.S. Supreme Court issued its amended decree in 1988, New Mexico's efforts, including a total taxpayer investment of more than $130 million, have resulted in continued Compact compliance.
    - The Pecos Settlement Agreement was signed in 2003 and implemented in June 2009 after New Mexico had acquired water rights associated with about 4,500 acres of land in the CID and about 7,500 acres in the Roswell Artesian Underground Water Basin. Using these and other water rights, the State has constructed two well fields and pipelines designed to augment Pecos River flows according to the terms laid out in the Settlement.
    - New Mexico has accumulated a Compact delivery credit of just over 100,000 acre-feet, providing some protection against a Compact delivery deficit.
    - As a condition of the Pecos Settlement, the adjudication of CID water rights is nearly complete.
- Drought has significantly affected the region, with 2011, 2012, and 2013 being extraordinarily dry (until September 2013), resulting in record low flows in the Pecos

River. As a consequence, even with continuous augmentation pumping by the NMISC in much of 2011, 2012, and 2013, it was not possible to meet the minimum Carlsbad Project supply target above which CID cannot call for priority administration pursuant to the 2003 Pecos Settlement Agreement. CID demanded a priority call until September 2013, when storm flows relieved the water shortage.

- Continued compliance with the USFWS's 2006 Biological Opinion (BO) for the threatened Pecos bluntnose shiner is an ongoing challenge. The State of New Mexico, the Bureau of Reclamation, and Pecos Basin water user groups have collaborated to comply with the BO; however, acquisition of additional water rights is needed to ensure long-term Endangered Species Act compliance.

- Communities such as Ruidoso and Otis have historically experienced serious water supply problems during drought years. Continued drought planning is needed to design measures to ensure that essential water needs can be met.

- The net water supply impacts of physical watershed management techniques are not well documented or understood. In particular, quantification of the effectiveness of riparian vegetation removal, upland conifer thinning, and other water salvage methods needs further study to support well informed decisions.

- Water managers need to ensure continued compliance with the terms of the 2003 Pecos Settlement and the 1988 U.S. Supreme Court amended decree.

- Oil and gas development in the Capitan and Carlsbad basins raises concerns over potential impacts to the Pecos River and stress on the aquifers. Domestic, stock, and commercial wells permitted under 72-12-1.3 (underground public waters temporary use), along with new appropriations permitted under 72-12-3, are used to supply the oil and gas industry. With respect to wells permitted under 72-12-1.3, the NMOSE allows well owners to pump up to 9 acre-feet a year per well under three separate temporary commercial permits that are approved without advertising the change of use in the legal section of the newspaper. Well owners must reapply each year for these temporary permits.

Strategies to Meet Future Water Demand

An important focus of the RWP update process is to both identify strategies for meeting future water demand and support their implementation. To help address the implementation of new strategies, a review of the implementation of previous strategies was first completed.

The 2001 Lower Pecos Valley Regional Water Plan recommended the following strategies for meeting future water demand:

- Managed well field operations
- Desalination
- Interstate pipeline
- Import Salt Water Basin water
- Cloud seeding
- Reduce conveyance losses
- Agricultural water conservation
- Municipal water conservation
- Industrial water conservation
- Moving reservoir storage
- Construct additional reservoirs
- Reduce reservoir surface area
- Dewater McMillan Delta
- Riparian vegetation management
- Enhanced water market
- Enhanced administrative enforcement
- Compact compliance

The steering committee reviewed each of the strategies and indicated that most are still relevant, though some are being refocused as new recommended strategies. The steering committee would prefer to see a balanced approach to water use before importation of water from other regions is considered.

During the two-year update process the Lower Pecos Valley Steering Committee and stakeholders identified projects, programs, and policies (PPPs) to address their water issues. Some water projects were already identified through the State of New Mexico Infrastructure Capital Improvement Plan, Water Trust Board, Capital Outlay, and New Mexico Environment Department funding processes; these projects are also included in a comprehensive table of PPP needs. The information was not ranked or prioritized; it is an inclusive table of all of the PPPs that regional stakeholders are interested in pursuing. These new strategies include:

- Groundwater monitoring
- Watershed restoration and management

- Funding for National Environmental Policy Act (NEPA) / Environmental Impact Statement (EIS) compliance
- Conservation funding
- Drought preparedness
- Produced water reuse
- Re-operate leaky reservoirs
- Increase recharge
- Aquifer storage and recovery
- Regional system collaboration
- Domestic Well Permits and Metering
- Incentives to Preserve Agricultural Water
- Protect New Mexico water
- Limit new uses
- Close the Basin

At steering committee meetings held in 2015 and 2016, the group discussed strategies that would have a larger regional or sub-regional impact and for which there is interest in collaboration to seek funding and for implementation. The following key collaborative strategies were identified by the steering committee and Lower Pecos Valley region stakeholders:

- *Managed Well Field Operations.* Minimize well field impacts and explore alternatives.
- *Agricultural Water Conservation*. Increase efficiency and preserve agricultural rights.
- *Municipal Water Conservation.* Encourage water planning, infrastructure upgrades, and leak detection. Collaboration between small rural providers will allow pooling of resources and staff.
- *Industrial Water Conservation*. Produced water reuse is a key issue for this region and could potentially reduce water shortages. Greater measures need to be taken to make produced water reuse more feasible.
- *Watershed Management.* Management and protection of recharge areas is important.
- *NEPA / EIS Support*. Increase funding for NEPA or EIS analysis required for project implementation.

- *Increase Recharge.* Several ideas are presented to increase recharge including easing restrictions on water quality used for aquifer storage and river discharge, re-operating leaky reservoirs as recharge points for aquifers, and better management of watersheds.
- *Compact Compliance.* Additional studies are needed to develop alternatives to meeting the Pecos River Compact. Are the impacts of the current strategies as anticipated, or have there been unintended consequences?

The 2016 RWP characterizes supply and demand issues and identifies strategies to meet the projected gaps between water supply and demand. This plan should be added to, updated, and revised to reflect implementation of strategies, address changing conditions, and continue to inform water managers and other stakeholders of important water issues affecting the region.

1. Introduction

The Pecos River Basin encompasses the entire Pecos River watershed within the boundaries of New Mexico. The Basin has upper and lower reaches that are distinct and are treated differently under the Pecos River Compact. The upper basin extends from the river's headwaters area in the Sangre de Cristo Mountains to Sumner Dam. The lower basin extends from Sumner Dam to the Texas state line. The Sumner Dam (formerly Alamogordo Dam) is about 12 miles northwest of Fort Sumner, New Mexico.

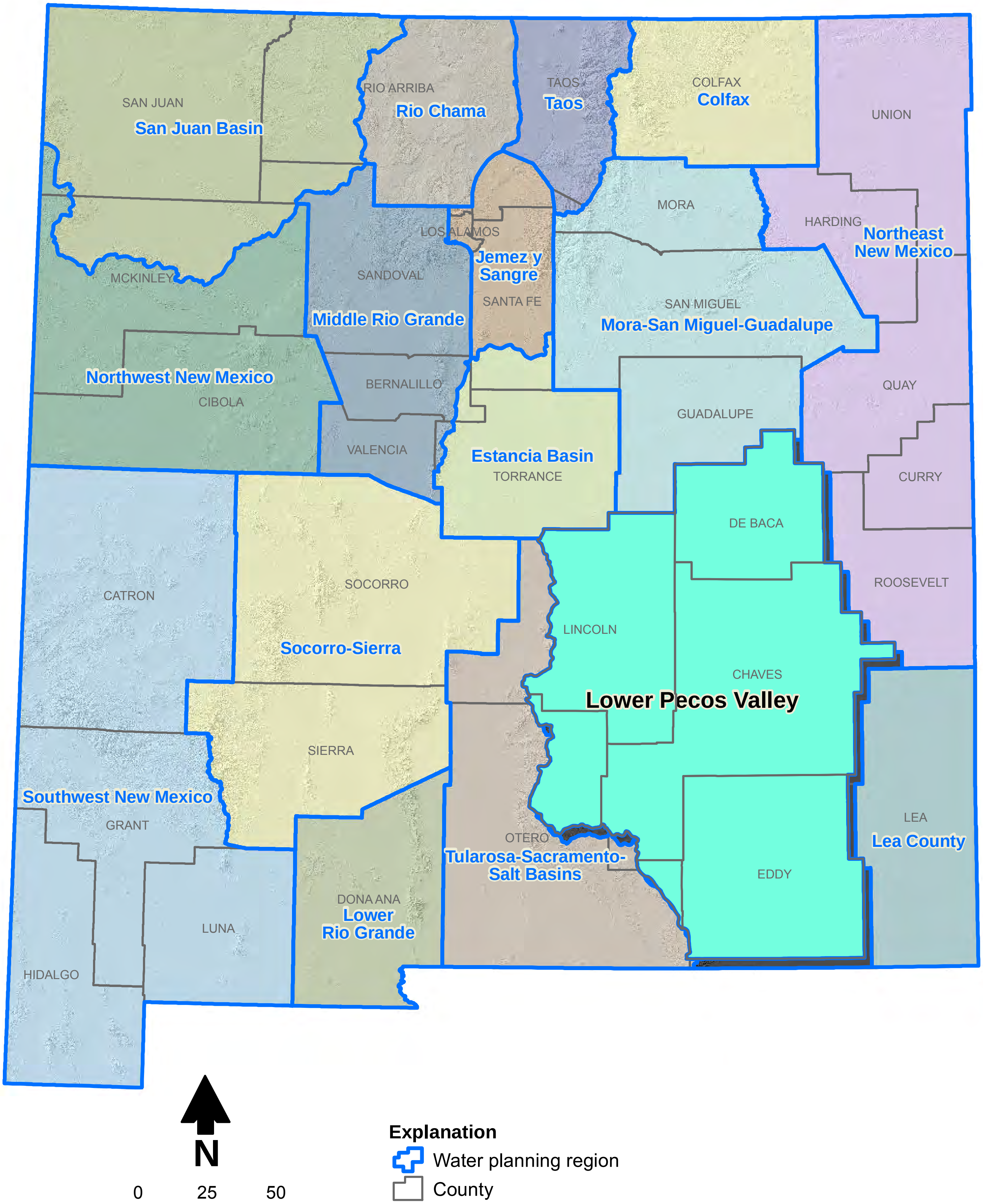
The Lower Pecos Valley Water Planning Region, which includes all of De Baca County and parts of Lincoln, Chaves, Otero, and Eddy counties (Figure 1-1), is one of 16 water planning regions in the State of New Mexico. The region roughly coincides with the Lower Pecos River Basin and is bounded on the north by Torrance and Guadalupe counties, on the east by Roosevelt and Lea counties, on the west by the watershed divide in Lincoln and Otero counties, and on the south by the New Mexico-Texas state line.

Regional water planning was initiated in New Mexico in 1987, its primary purpose being to protect New Mexico water resources and to ensure that each region is prepared to meet future water demands. Between 1987 and 2008, each of the 16 planning regions, with funding and oversight from the New Mexico Interstate Stream Commission (NMISC), developed a plan to meet regional water needs over the ensuing 40 years.

The Pecos Valley Water Users Organization (PVWUO) has been active in water planning in the region since the 1970s and has historical roots back to the 1880s. The Lower Pecos Valley Regional Water Plan was completed in July 2001 (PVWUO, 2001) and accepted by the NMISC on August 23, 2001.

The purpose of this document is to provide new and changed information related to water planning in the Lower Pecos Valley region, as listed in the bullets below, and to evaluate projections of future water supply and demand for the region using a common technical approach applied to all 16 planning regions statewide. Accordingly, the following sections summarize key information in the 2001 plan and provide updated information regarding changed conditions and additional data that have become available. Specifically, this update:

- Identifies significant new research or data that provide a better understanding of current water supplies and demands in the Lower Pecos Valley region.
- Presents recent water use information and develops updated projections of future water demand using the common technical approach developed by the NMISC, in order to facilitate incorporation into the New Mexico State Water Plan.



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LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Location of Lower Pecos Valley Water Planning Region

Figure 1-1

- Identifies strategies, including infrastructure projects, conservation programs, watershed management policies, or other types of strategies that will help to balance supplies and projected demands and address the Lower Pecos Valley region's future water management needs and goals.
- Discusses other goals or priorities as identified by stakeholders in the region.

The water supply and demand information in this regional water plan (RWP) is based on current published studies and data and information supplied by water stakeholders in the region. Tribes and pueblos in New Mexico are not required to provide water use data to the State, and so tribal water use data are not necessarily reflected in this RWP update.

The organization of this update follows the template provided in the *Updated Regional Water Planning Handbook: Guidelines to Preparing Updates to New Mexico Regional Water Plans* (NMISC, 2013) (referred to herein as the Handbook):

- Information regarding the public involvement process followed during development of this RWP update and entities involved in the planning process is provided in Section 2.
- Section 3 provides background information regarding the characteristics of the Lower Pecos Valley planning region, including an overview of updated population and economic data.
- The legal framework and constraints that affect the availability of water are briefly summarized in Section 4, with recent developments and any new issues discussed in more detail.
- The physical availability of surface water and groundwater and water quality constraints was discussed in detail in the 2001 RWP; key information from that plan is summarized in Section 5, with new information that has become available since 2001 incorporated as applicable. In addition, Section 5 presents updated monitoring data for temperature, precipitation, drought indices, streamflow, groundwater levels, and water quality, and an estimate of the administrative water supply including an estimate of drought supply.
- The information regarding historical water demand in the planning region, projected population and economic growth, and projected future water demand was discussed in detail in the 2001 RWP. Section 6 provides updated population and water use data, which are then used to develop updated projections of future water demand.
- Based on the current water supply and demand information discussed in Sections 5 and 6, Section 7 updates the projected gap between supply and demand of the planning region.
- Section 8 outlines new strategies (water programs, projects, or policies) identified by the region as part of this update, including additional water conservation measures.

Water supply and demand information (Sections 5 through 7) are assessed in accordance with a common technical approach, as identified in the Handbook (NMISC, 2013) (where it is referred to as a common technical *platform*). This common technical approach is a simple methodology that can be used consistently across all regions to assess supply and demand, with the objective of efficiently developing a statewide overview of the balance between supply and demand for planning purposes.

Four terms frequently used when discussing water throughout this plan have specific definitions related to this RWP:

- *Water use* is water withdrawn from a surface or groundwater source for a specific use. In New Mexico water is accounted for as one of the nine categories of use in the *New Mexico Water Use by Categories 2010* report prepared by the New Mexico Office of the State Engineer (NMOSE).
- *Water withdrawal* is water diverted or removed from a surface or groundwater source for use.
- *Administrative water supply* is based on the amount of water withdrawals in 2010 as outlined in the *New Mexico Water Use by Categories 2010* report.
- *Water demand* is the amount of water needed at a specified time.

Common Technical Approach

To prepare both the regional water plans and the state water plan, the State has developed a set of methods for assessing the available supply and projected demand that can be used consistently in all 16 planning regions in New Mexico. This common technical approach outlines the basis for defining the available water supply and specifies methods for estimating future demand in all categories of water use:

- The method to estimate the available supply (referred to as the *administrative water supply* in the Handbook) is based on withdrawals of water as reported in the *NMOSE Water Use by Categories 2010* report,* which provide a measure of supply that considers both physical supply and legal restrictions (i.e., the diversion is physically available for withdrawal, and its use is in compliance with water rights policies) and thus reflects the amount of water available for use by a region. An estimate of supply during future droughts is also developed by adjusting the 2010 withdrawal data based on physical supplies available during historical droughts.
- Projections of future demands in nine categories of water use are based on demographic and economic trends and population projections. Consistent methods and assumptions for each category of water use are applied across all planning regions.

The objective of applying this common technical approach is to be able to efficiently develop a statewide overview of the balance between supply and demand in both normal and drought conditions, so that the State can move forward with planning and funding water projects and programs that will address the State's pressing water issues.

* *Tribes and Pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this plan.*

2. Public Involvement in the Planning Process

During the past two years, the regional water planning steering committees, interested stakeholders, NMISC, and consultants to the NMISC have worked together to develop regional water plan updates. The purpose of this section is to describe public involvement activities during the regional water plan update process, guided by the Handbook, which outlined a public involvement process that allowed for broad general public participation combined with leadership from key water user groups.

2.1 The New Mexico Interstate Stream Commission's Role in Public Involvement in the Regional Water Plan Update Process

The NMISC participated in the public involvement process through a team of contractors and NMISC staff that assisted the regions in conducting public outreach. The NMISC's role in this process consisted of certain key elements:

- Setting up and facilitating meetings to carry out the regional water plan update process.
- Working with local representatives to encourage broad public involvement and participation in the planning process.
- Working to re-establish steering committees in regions that no longer had active steering committees.
- Supporting the steering committees once they were established.
- Facilitating input from the stakeholders and steering committees in the form of compiling comments to the technical sections drafted by the State and developing draft lists of projects, programs, and policies (PPPs) based on meeting input, with an emphasis on projects that could be implemented.
- Finalizing Section 8, Implementation of Strategies to Meet Future Water Demand, by writing a narrative that describes the key collaborative strategies based on steering committee direction.

This approach represents a change in the State's role from the initial round of regional water planning, beginning in the1990s through 2008, when the original regional water plans were developed. During that phase of planning, the NMISC granted regions funding to form their own regional steering committees and hire consultants to write the regional water plans, but NMISC staff were not directly involved in the process. Over time and due to lack of resources, many of the regional steering committees established for the purpose of developing a region's water plan disbanded. Funding for regional planning decreased significantly, and regions were not meeting to keep their plans current.

In accordance with the updated Handbook (NMISC, 2013), the NMISC re-established the regional planning effort in 2014 by working with existing local and regional stakeholders and organizations, such as regional councils of government, water providers, water user organizations, and elected officials. The NMISC initiated the process by hosting and facilitating meetings in all 16 regions between February and August of 2014. During these first months, and through its team of consultants working with contacts in the regions, the NMISC prepared "master stakeholder" lists, comprised of water providers and managers, local government representatives, and members of the public with a general interest in water, and assisted in developing updated steering committees based on criteria from the Handbook and recommendations from the stakeholders. (The steering committee and master stakeholder lists for the Lower Pecos Valley region are provided in Section 2.2.1 and Appendix 2-A, respectively.) These individuals were identified through research, communication with other water user group representatives in the region, contacting local organizations and entities, and making phone calls. Steering committee members represent the different water users groups identified in the Handbook and have water management expertise and responsibilities.

The steering committee was tasked with four main responsibilities:

- Provide input to the water user groups they represent and ensure that other concerned or interested individuals receive information about the water planning process and meetings.
- Provide direction on the public involvement process, including setting meeting times and locations and promoting outreach.
- Identify water-related PPPs needed to address water management challenges in the region and future water needs.
- Comment on the draft *Lower Pecos Valley Regional Water Plan 2016*, as well as gather public comments. (Appendix 2-B includes a compilation of comments on the technical and legal sections of the document that were prepared by NMISC [Sections 1, 3, 4, 5, 6, and 7].)

In 2016, the NMISC continued to support regional steering committees by facilitating three additional steering committee meetings open to the public in each of the 16 regions. The purpose of these meetings was to provide the regions with their draft technical sections that the NMISC had developed and for the regions to further refine their strategies for meeting future water challenges.

Throughout the regional water planning process all meetings were open to the public. Members of the public who have an interest in water were invited directly or indirectly through a steering committee representative to participate in the regional water planning process

Section 2.2 provides additional detail regarding the public involvement process for the Lower Pecos Valley 2016 regional water plan.

2.2 Public Involvement in the Lower Pecos Valley Planning Process

This section documents the steering committee and public involvement process used in updating the plan and documenting ideas generated by the region for future public involvement in the implementation of the plan.

2.2.1 Identification of Regional Steering Committee Members and Stakeholders

The Handbook (NMISC, 2013) specifies that the steering committee membership include representatives from multiple water user groups. Some of the categories may not be applicable to a specific region, and the regions could add other categories as appropriate to their specific region. The steering committee representation listed in the Handbook includes:

- Agricultural – surface water user
- Agricultural – groundwater user
- Municipal government
- Rural water provider
- Extractive industry
- Environmental interest
- County government
- Local (retail) business
- Tribal entity
- Watershed interest
- Federal agency
- Other groups as identified by the steering committee

The PVWUO was formed under a joint powers agreement and participated in the development of the 2001 RWP. The PVWUO is a well-established organization with some roots going back as far as the 1800s. This organization worked on the 2001 regional plan by collecting a wide variety of data sources, historical studies, and the best currently available data to help guide the regional objectives. The PVWUO has limited funds and no legislative authority, and therefore it does not fund, supervise, or carry out projects. While other organizations in the state disbanded after the last round of regional planning, this organization saw the value in having a non-legal, non-binding forum for communication and free exchange of ideas, needs and assistance. They continued to meet at least annually, but more often quarterly until the current planning process began.

The current steering committee includes many PVWUO members, as well as several new members, including a State representative, several municipal providers, and tribal interests. These individuals are generally knowledgeable about water issues in the region and are involved with many of the PPPs related to water management in the region. The list also includes non-profit groups who are involved in local water-related initiatives. The steering committee identified Woods Houghton as the Chair. Other steering committee members were recruited through recommendations and outreach to specific interests such as tribal entities. Through this outreach, the Lower Pecos Valley region established a representative steering committee, the members of which are listed in Table 2-1.

2.2.2 Regional Water Plan Update Meetings

All steering committee meetings and NMISC-facilitated water planning meetings were open to the public and interested stakeholders. Meetings were announced to the master stakeholder list by e-mail, and participation from all meeting attendees was encouraged. Steering committee members served as a conduit of information to others and, through their own organizational communications with other agencies, encouraged participation in the process. Steering committee members were also asked to share information about the process with other stakeholders in the region. Generally, steering committee members ensured that other concerned or interested individuals received the announcements and recommended key contacts to add to the master stakeholder list throughout the planning process.

The steering committee discussed and made the following recommendations regarding meeting times and locations that would maximize public involvement in the future:

- Host a web meeting where county extension offices and city, county and federal offices could arrange for public participation. New Mexico State University can host up to 100 computers logging in for a webinar.
- Artesia is the preferred location for physical meetings, but Roswell or Carlsbad are also options.
- Eddy County Fairgrounds, Eastern New Mexico University, and New Mexico State University are possible meeting places.
- Meetings are currently scheduled for Friday mornings; however, weekends or evenings would be needed for large public meetings.
- Steering committee members will continue to assist with outreach. Steering committee members will help identify communities not currently represented at the meetings (such as Mayhill).

Over the two-year update process, nine NMISC-facilitated meetings and at least five steering committee working meetings were held in the Lower Pecos Valley region. A summary of each of the meetings is provided in Table 2-2.

Table 2-1. Steering Committee Members, Lower Pecos Valley Water Planning Region

Water User Group	Name	Organization / Representation
Agricultural – groundwater user	Dick Smith Aron Balok	PVACD
	Cheryl Griffith Janet Cox	Ranching community
	Dan Lathrop	Hagerman Irrigation District
Agricultural – surface water user	Dale Ballard	Carlsbad Irrigation District
	Lex Klein	Hope Community Ditch
	Wade Holdeman	Fort Sumner Irrigation District
County government	James Walterscheid	Eddy County Commissioner
	Lewis Derrick	Former Eddy County Commissioner
	Jackie Powell	Former Lincoln County Commissioner
	Morgan Nelson	Chaves County Flood Commission
	Aspen Achen	De Baca County Commission
Environmental interest	Ellen Wedum	Ms. Wedum participated in 2015, prior to moving
Extractive industry		Holly Energy or Yate Petroleum (desired)
Federal agency	Pete Haraden	Hydrologist with Lincoln National Forest (U.S. Forest Service)
State agency	Jim Townsend	New Mexico State Representative
	Lewis Land	New Mexico Bureau of Geology and Mineral Resources National Cave and Karst Research Institute
Local (retail) business		
Soil and Water Conservation District	Woods Houghton	Eddy County Agricultural Extension Agent for NMSU
Municipal government	Terry Hill Byron Landfair	City of Artesia
	Debi Lee Ron Sena Eric Boyda	Village of Ruidoso
	Jean Coulton	Village of Capitan
	Steve Croskey Wesley Hooper	Eddy County Planner
Other groups as identified by the steering committee	Stephanie Bosen Kristi Bonnell	Upper Hondo SWCD
Rural water provider		
Tribal (Mescalero Apache Tribe)	Thora Padilla	Director of Resource Management & Protection Division
Watershed interest		

Table 2-2. Lower Pecos Valley Region Public Meetings
Page 1 of 3

Date	Location	Purpose	Meeting Summary
FY 2014			
05/09/2014	Artesia, NM	NMISC-facilitated kickoff meeting to present the regional water planning update process to the region and continue to conduct outreach to begin building the steering committee.	Representatives from many of the water user groups attended the meeting and were instrumental in identifying other individuals as potential representatives for a particular group. Many of the meeting attendees were not on the master stakeholder list, and those individuals were added to the list.
FY 2015			
02/13/2015	Eddy County Fairgrounds Artesia, NM	NMISC-facilitated meeting to present the technical data compiled and synthesized for the region.	Data presented included population and economic trends through a series of tables, the administrative water supply, the projected future water demand, and the gap between supply and demand for both normal and drought years. In addition, the presentation reaffirmed the development of a steering committee to guide the process as outlined in the Handbook.
03/13/2015	Eddy County Fairgrounds Artesia, NM	NMISC-facilitated steering committee meeting to review the update process and the timeline for completing the regional water plan (RWP) update. Set up meeting times and locations for future meetings.	The group reviewed the update process, which was important for new people who had not attended meetings before, and the timeline for updating the RWP. The steering committee/PVWUO membership and leadership were affirmed, with alternates named as appropriate. The group further discussed where future meetings would be held and the time that worked the best for getting the most attendance. The majority, including the members from Ruidoso and Hondo, preferred meeting in Artesia (Roswell and Carlsbad were discussed). The meetings will occur the second Friday of each month, at 10:00 a.m. At this meeting, the group also reviewed strategies outlined in the 2001 plan. A date was set for the next meeting and a summary of the discussion was sent to the master stakeholder list with information about the next meeting—including agenda items and location, date, and time–and next steps.

Table 2-2. Lower Pecos Valley Region Public Meetings
Page 2 of 3

Date	Location	Purpose	Meeting Summary
04/10/2015	Eddy County Fairgrounds Artesia, NM	Steering committee meeting to learn from committee members about the status of ongoing projects in the area.	The group discussed concerns with the data provided in the Round 2 meeting and possible policies to help address these issues. A representative of the New Mexico Water Resources Research Institute (WRRI), Mr. Saddie, presented current research on produced water. The group further discussed potential collaborative projects such as local and state water policy recommendations, monitoring/data collection, drought contingency planning, municipal conservation and reuse, and water quality protection.
5/22/2015	Agricultural Science Center Artesia, NM	NMISC-facilitated meeting to develop project ideas for the PPP table and community outreach ideas for Section 2.	The group discussed elements that would be included in the public involvement chapter and ideas for FY 2015-2016 outreach. A potential list of Infrastructure and Capital Improvement (ICIP) and Water Trust Board (WTB) projects was reviewed and discussed. The group participated in a brainstorming activity that helped to identify regional projects that held the potential for the greatest collaboration and effort.
06/05/2015	Agricultural Science Center Artesia, NM	Steering Committee meeting to review programs and policies for the PPP table and Section 8.	This was an informal meeting/workshop to discuss the possibility of prioritizing projects on the PPP table. Many PPPs were discussed, but no motions were made or passed.
06/12/2015	Eddy County Fairgrounds Artesia, NM	NMISC-facilitated meeting to review Drafts of Section 2 and the PPP table.	The table of PPPs was reviewed at this final NMISC-facilitated meeting for /FY 2015.
FY 2016			
08/14/2015	Agricultural Science Center, Artesia, NM	Steering committee meeting to review programs and policies for the PPP table and Section 8.	Refinement of the PPP table was discussed with several new programs and goals voted upon.

Table 2-2. Lower Pecos Valley Region Public Meetings
Page 3 of 3

Date	Location	Purpose	Meeting Summary
02/26/2016	Eddy County Fairgrounds Artesia, NM	NMISC-facilitated meeting to review the update process and timeline for completion. Review steering committee makeup.	Discussed that the draft plan had been e-mailed to the Lower Pecos distribution list in January 2016. The consultants affirmed the next steps for the RWP update effort and the timeline for meetings. The group reviewed the steering committee membership and discussed additional members to fill vacancies and decided that steering committee leadership would continue as is for now.
03/11/2016	Agricultural Science Center, Artesia, NM	Steering committee meeting to review programs and policies for the PPP table and Section 8.	Several new programs and policies were discussed for inclusion in the PPP table. Corrections to the June 2015 draft were also discussed. The steering committee does not specifically endorse projects from the ICIP or WTB database.
04/08/2016	Eddy County Fairgrounds Artesia, NM	NMISC-facilitated meeting to discuss how comments would be documented and review the PPP table.	Plans for distribution of the draft plan and public announcements were finalized. Review of the PPP table and corrections to the table were made. Regional priorities and recommendations for the state plan were discussed.
05/13/2016	Agricultural Science Center Artesia, NM	Steering committee meeting to review comments.	The steering committee reviewed comments collected on the draft RWP.
05/20/2016	Eddy County Fairgrounds Artesia, NM	NMISC-facilitated meeting to review the Public Involvement section (2) and the Section 8 key strategies and projects, programs and policies list.	The steering committee reviewed the draft Section 8, Section 2, and PPP tables. The discussion centered on finalizing the PPP tables, and a further meeting was scheduled to finish the review process.
06/10/2016	Eddy County Fairgrounds Artesia, NM	NMISC-facilitated meeting to finish review of Section 2 and Section 8.	The steering committee finished reviewing the draft material, focusing on Sections 2 and 8 at this meeting. A resolution on the planning process limitations was also created by the committee.

2.2.3 Current and Future Ideas for Public Outreach during Implementation of the Regional Water Plan Update

The public involvement process was centered on developing a representative steering committee, informing the regions about the process for updating the RWPs, and revitalizing interest in regional water planning. In addition to the stakeholder outreach described above, the steering committee solicited public input on the draft plan in several formats. A news release was made to local media regarding the plan, a Facebook page was created that provided links to the plan and shared regional water topics, and an E-blog was distributed to a growing e-mail list. These efforts resulted in a few public comments, which are included in the review and comment process.

3. Description of the Planning Region

This section provides a general overview of the Lower Pecos Valley Water Planning Region. Detailed information, including maps illustrating the land use and general features of the region, was provided in the 2001 RWP; that information is briefly summarized and updated as appropriate here. Additional detail on the climate, water resources, and demographics of the region is provided in Sections 5 and 6.

3.1 General Description of the Planning Region

The Lower Pecos Valley Water Planning Region is located in southeastern New Mexico. The region is bounded on the north by Torrance, Guadalupe, and Quay counties, on the west by the watershed divide in Lincoln and Otero counties, on the south by the state line separating New Mexico and Texas, and on the east by Lea and Roosevelt counties (Figure 1-1). In 2010, the population of the Lower Pecos Valley Planning Region was about 144,000 (Table 3-1a). The major population centers in the region are Roswell, Artesia, and Carlsbad.

The Lower Pecos River Basin encompasses about 15,150 square miles between Sumner Dam and the Texas state line. Almost all of De Baca, Chaves, and Eddy counties, significant parts of Lincoln and Otero counties, and minor parts of several other counties fall within the basin. The northern and eastern boundaries of the planning region (Figure 3-1) vary slightly from the river basin boundaries, but the vast majority of the planning region population is located within the river basin.

Table 3-1. Summary of Demographic and Economic Statistics for the Lower Pecos Valley Water Planning Region
Page 1 of 2

a. Population

County	2000 Total	2010		2013
		Total	Within Region [a]	
DeBaca	2,240	2,022	2,022	1,907
Lincoln	19,411	20,497	18,941	20,105
Chaves	61,382	65,645	65,614	65,823
Otero	62,298	63,797	3,372	65,616
Eddy	51,658	53,829	53,816	55,471
Total Region	196,989	205,790	143,796	208,922

Source: U.S. Census Bureau, 2014a, unless otherwise noted.
[a] U.S. Census Bureau, 2010

b. Income and Employment

County	2008-2012 Income [a]		Labor Force Annual Average 2013 [b]		
	Per Capita ($)	Percentage of State Average	Number of Workers	Number Employed	Unemployment Rate (%)
DeBaca	19,357	82	809	772	4.6
Lincoln*	24,960	105	10,130	9.564	5.6
Chaves	19,433	82	25,786	24,112	6.5
Otero	NA	NA	NA	NA	NA
Eddy	27,092	114	30,883	29,631	4.1

[a] U.S. Census Bureau, 2014c, American Community Survey 5-Year Estimate
[b] NM Department of Workforce Solutions, 2014

c. Business Environment

County	Industry	Number Employed	Number of Businesses
	2008-2012 [a]		*2012* [b]
DeBaca	Education/Healthcare Agriculture, forestry, mining Construction	229 154 58	47
Lincoln*	Arts, entertainment, recreation, accommodations Education/healthcare Retail trade Construction	1,983 1,640 1,124 753	707

Table 3-1. Summary of Demographic and Economic Statistics for the Lower Pecos Valley Water Planning Region
Page 2 of 2

c. Business Environment (continued)

County	Industry	Number Employed	Number of Businesses
Chaves	Education/Healthcare Retail trade Arts, entertainment, recreation, accommodations Agriculture, forestry, mining	7,301 3,198 2,712 2,540	1,433
Otero	NA	NA	NA
Eddy	Education/Healthcare Agriculture, forestry, mining Arts, entertainment, recreation, accommodations Retail trade	5,115 4,352 2,214 2,048	1,306

[a] U.S. Census Bureau, 2014b

d. Agriculture

County	Farms / Ranches [a]			Most Valuable Agricultural Commodities [b]
	Number	Acreage		
		Total	Average	
DeBaca	203	1,068067	5,261	Cattle, calves Other crops, hay
Lincoln*	362	1,553,184	4,291	Cattle, calves Sheep, goats, wool
Chaves	595	2,482,827	4,173	Milk from cows Cattle and calves Other crops, hay
Otero	NA	NA	NA	NA
Eddy	551	1,141,956	2,073	Milk from cows Other crops, hay Cattle and calves

[a] USDA NASS, 2014, Table 1
[b] USDA NASS, 2014, Table 2

Source:
Tribal boundaries from U.S. Census Bureau, 2015.

Explanation

- Stream (dashed where intermittent)
- Lake
- City
- County
- Water planning region

Elevation (ft msl)

- < 4,000
- 4,000 - 6,000
- 6,000 - 8,000
- 8,000 - 10,000
- >10,000

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Regional Map

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Figure 3-1

The total area of the planning region is approximately 17,133 square miles, distributed among the five counties as follows:

- De Baca: 2,332
- Lincoln: 3,499
- Chaves: 5,941
- Otero: 1,190
- Eddy: 4,171

The Lower Pecos Valley region's terrain is diverse, with elevations ranging from about 12,000 feet above mean sea level (ft amsl) at Sierra Blanca Peak near Ruidoso to about 2,840 ft amsl at the Pecos River where it crosses the New Mexico-Texas border near Red Bluff. The western portion contains steep forested mountains, and the southern and eastern areas support desert shrubs and desert grasslands. The northern and central portions of the planning area are covered with rolling hills and high plains grasslands. This diverse terrain supports large populations of wildlife and non-game species and both warm-water and cold-water fisheries.

The planning area has an abundance of mineral resources. The southeastern part of the planning area is home to one of the largest potash mining industries in the United States. Gold and silver have been mined in the western areas, and oil and gas production is a major industry in the region.

3.2 Climate

The climate throughout the planning area is as varied as the landscape.

- The mountainous areas have a short growing season with mild days and cool nights. The mountains usually acquire snow cover during the winter months with temperatures averaging 35 degrees Fahrenheit (°F) and average summer temperatures are 65°F.
- The southern desert areas are characterized by growing seasons that sometimes exceed 200 days with hot, dry days and warm nights. Although winters in these desert areas are generally mild, average winter temperatures are about 45°F and average summer temperatures are 80°F.
- The plains area experiences a slightly shorter growing season and temperatures typically 5 to 15 degrees cooler.

Average annual precipitation varies orographically; the lowest areas near the state line receive about 10 to 12 inches and the highest elevation areas in the Sacramento Mountains receive more than 40 inches per year (in/yr). The annual precipitation also varies significantly from year to year, which not only impacts runoff and recharge but also has a significant impact on the irrigation water demand. In 2003, Roswell received only about 3 inches of rain, and annual groundwater pumping was 372,700 acre-feet, whereas in 2010, the annual precipitation exceeded 15 inches and groundwater pumping totaled 309,000 acre-feet in the Roswell Basin. The years 2011 and 2012 were the hottest and driest 24 months in the 117-year record, resulting in record low streamflows and high pumping demands (approximately 380,000 acre-feet).

3.3 Major Surface Water and Groundwater Sources

The Pecos Valley has always been a region limited by available water. Water users in the planning area rely on supplies from both surface water and groundwater sources, but the Pecos River tributaries in the basin (Figure 3-1) provide limited and variable flow. Potential demands have always exceeded supply, and the requirements of the Pecos River Compact to deliver specified amounts of surface water to Texas exacerbate the region's water supply issues. Groundwater supplies currently satisfy the majority of water demands in the planning area.

The region falls in the lower portion of the Pecos River drainage basin in New Mexico. Surface water is diverted directly from the Pecos River and its major tributaries, such as the Rio Hondo, Rio Ruidoso, Rio Peñasco, Black River, and Rio Bonito, and in some cases the diverted water is stored in reservoirs both outside and within the planning area. Ponds on intermittent streams are a water source for both livestock and wildlife. Supplies of the Pecos River Basin are shared with the Estancia Basin and Mora-San Miguel-Guadalupe planning regions, as well as the State of Texas.

Groundwater is pumped from geological formations that yield from 5,000 to less than 1 gallon of water per minute (gpm). There are six administratively (OSE) declared underground water basins (UWBs) in the planning area: Fort Sumner, Roswell, Hondo, Peñasco, Capitan, and Carlsbad. (A declared UWB is an area of the state proclaimed by the State Engineer to be underlain by a groundwater source having reasonably ascertainable boundaries. By such proclamation the State Engineer assumes jurisdiction over the appropriation and use of groundwater from the source.) The Roswell UWB is the largest developed groundwater resource in the region, providing flowing and non-flowing wells.

These UWBs are shared with the following water planning regions:

- Northeast New Mexico (Fort Sumner, Roswell)
- Estancia (Lower Pecos Valley, Fort Sumner)
- Lea County (Capitan, Carlsbad)

Very small portions of the Causey Lingo and Lea County UWBs also extend into the Lower Pecos Valley region, but these basins do not supply any significant quantities of water to the region. Detailed discussions of the characteristics of each UWB are provided in the 2001 RWP. A map showing the UWBs in the region is provided in Section 4.1.2.2.

Additional information on administrative basins and surface and groundwater resources of the region is included in Section 4 and Sections 5.2 and 5.3, respectively.

3.4 Demographics, Economic Overview, and Land Use

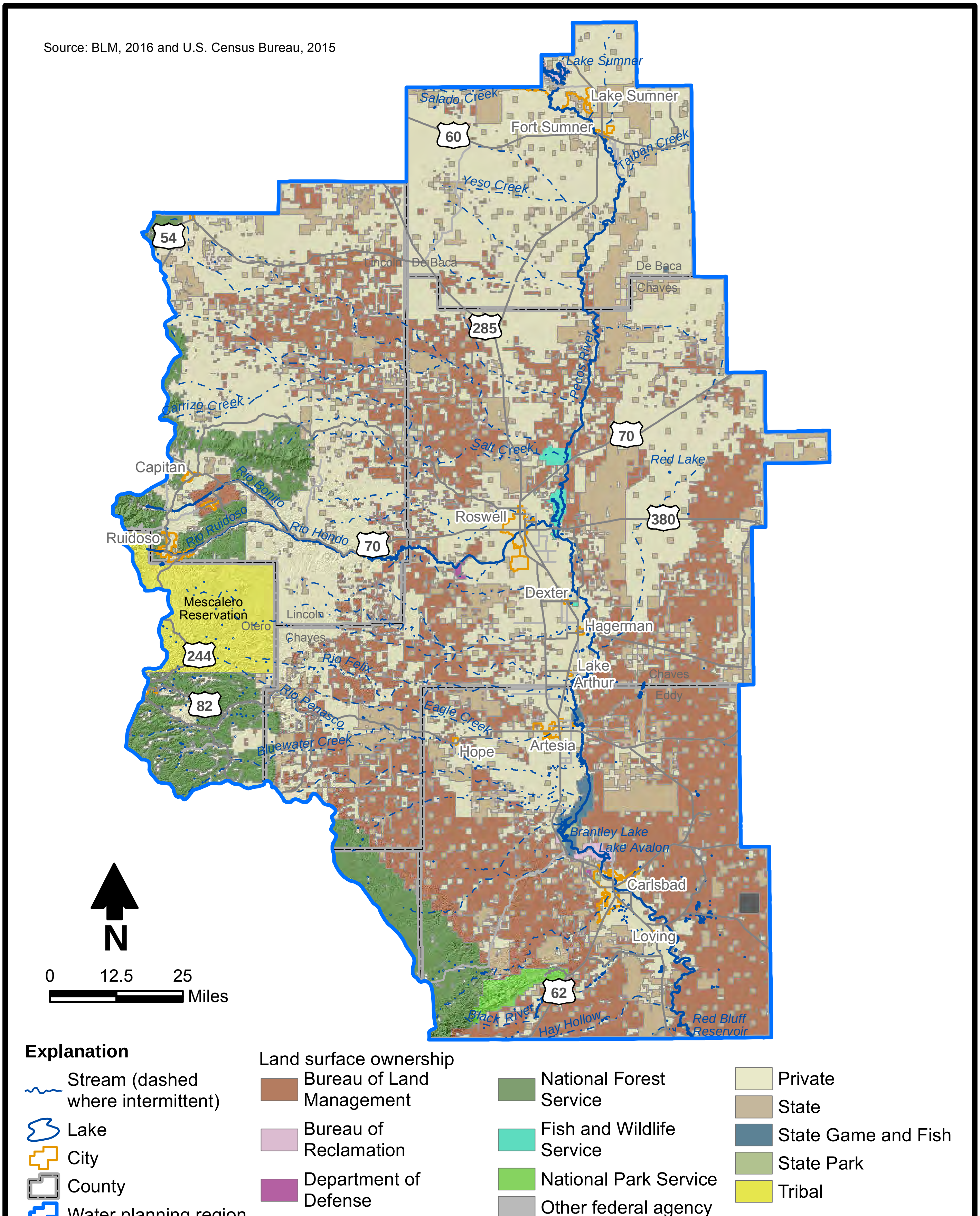
The Lower Pecos Valley Water Planning Region includes all of De Baca County, most of Chaves County (except for 31 persons), most of Eddy County (except for 13 persons), the majority of Lincoln County (except for 1,556 persons in 2010), and a small geographic section of Otero County that was home to 3,372 people in 2010 (U.S. Census Bureau, 2010). The 2013 population of De Baca County was 1,907 (U.S. Census Bureau, 2014a), a 5.7 percent decrease from the 2010 population (Table 3-1a). The 2013 population for all of Chaves County was 65,823, an increase of 0.3 percent from 2010. The 2013 population for all of Eddy County was 55,471, an increase of 3.1 percent over 2010. The 2013 population for all of Lincoln County was 20,105, a decrease of 1.9 percent from 2010.

The largest employment categories in De Baca County are education/healthcare and agriculture/mining. Both are considered basic industries (those that bring outside dollars into the local economy). Chaves County has a more diverse economy. The education and healthcare category is by far the largest employer, followed by retail trade; arts, entertainment, accommodation and food service; and agriculture. Eddy County is highly dependent on mining, its one basic export industry. Industries employing the most people are education and healthcare; retail trade; arts, entertainment, accommodation and food service; mining; and agriculture. In Lincoln County, the arts, entertainment, accommodation and food service category is the largest employer and the largest basic industry, reflecting Lincoln County's reliance on tourism; the next largest employers are education and healthcare and retail trade.

Land in the Lower Pecos Valley water planning region is owned by various federal, tribal, state, and private entities, as illustrated on Figure 3-2 and outlined below:

- Federal agencies: 6,103 square miles
- Tribes: 489 square miles
- State agencies: 2,586 square miles
- Private entities: 7,955 square miles

Current statistics on the economy and land use in each county, compiled from the U.S. Census Bureau and the New Mexico Department of Workforce Solutions, are summarized in Table 3-1. Additional detail on demographics and economics within the region is provided in Section 6.



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016
Land Ownership

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Figure 3-2

4. Legal Issues

4.1 Relevant Water Law

4.1.1 State of New Mexico Law

Since the accepted regional water plan for the Lower Pecos Valley Water Planning Region was published in 2001, there have been significant changes in New Mexico water law through case law, statutes, and regulations. These changes address statewide issues including, but not limited to, domestic well permitting, the State Engineer's authority to regulate water rights, administrative and legal review of water rights matters, use of settlements to allocate water resources, the rights appurtenant to a water right, and acequia water rights. New law has also been enacted to address water project financing and establish a new strategic water reserve. These general state law changes are addressed by topic area below. State law more specific to the Lower Pecos Valley region is discussed in Section 4.1.2.

4.1.1.1 Purchase of Water Rights to Ensure Compliance with the Pecos River Compact

In 2002, the New Mexico Legislature authorized expenditure of $30 million dollars on Pecos Basin water rights acquisition provided that the terms of NMSA 1978, Section 72-1-2.4 (2002) were met. According to the statute, the NMISC was tasked with purchase of land with associated water rights to augment the flows of the Pecos River in order to ensure compliance with the Pecos River Compact and the U.S. Supreme Court amended decree in *Texas v. New Mexico,* No. 65 original. The statute required that a settlement agreement be entered into between the State, the Carlsbad Irrigation District (CID), the Pecos Valley Artesian Conservancy District (PVACD), and the Fort Sumner Irrigation District prior to the acquisition of the property. The water rights and land purchases are central to the settlement agreement and to future compliance with the Pecos River Compact.

Subsequently, in 2008, the Legislature enacted NMSA 1978, § 72-1-2.6 (2008) allowing the NMISC to sell back the land while retaining the water rights and purchase additional water rights without also having to buy the associated land. A fund was also established to help the NMISC manage the land purchases. NMSA 1978, § 72-1-2.5 (2008).

4.1.1.2 Regulatory Powers of the NMOSE

Several cases have addressed the regulatory powers of the NMOSE. In 2003, the New Mexico Legislature enacted NMSA 1978, § 72-2-9.1, relating to the administration of water rights by priority date. The legislature recognized that "the adjudication process is slow, the need for water administration is urgent, compliance with interstate compacts is imperative and the state engineer has authority to administer water allocations in accordance with the water right priorities recorded with or declared or otherwise available to the state engineer." Section 72-2-

9.1(A). The statute authorized the State Engineer to adopt rules for priority administration in a manner that does not interfere with future or pending adjudications, creates no impairment of water rights other than what is required to enforce priorities, and creates no increased depletions.

Based on Section 72-2-9.1, the State Engineer promulgated the Active Water Resource Management (AWRM) regulations in December 2004. The regulation's stated purpose is to establish the framework for the State Engineer "to carry out his responsibility to supervise the physical distribution of water to protect senior water right owners, to assure compliance with interstate stream compacts and to prevent waste by administration of water rights." 19.25. 13.6 NMAC. In order to carry out this purpose, the AWRM regulations provide the framework for the promulgation of specific water master district rules and regulations. No district-specific AWRM regulations have been promulgated in the Lower Pecos Valley region at the time of writing.

The general AWRM regulations set forth the duties of a water master to administer water rights in the specific district under the water master's control. Before the water master can take steps to manage the district, AWRM requires the NMOSE to determine the "administrable water rights" for purposes of priority administration. The State Engineer determines the elements, including priority date, of each user's administrable water right using a hierarchy of the best available evidence, in the following order: (A) a final decree or partial final decree from an adjudication, (B) a subfile order from an adjudication, (C) an offer of judgment from an adjudication, (D) a hydrographic survey, (E) a license issued by the State Engineer, (F) a permit issued by the State Engineer along with proof of beneficial use, and (G) a determination by the State Engineer using "the best available evidence" of historical beneficial use. Once determined, this list of administrable water rights is published and subject to appeal, 19.25.13.27 NMAC, and once the list is finalized, the water master may evaluate the available water supply in the district and manage that supply according to users' priority dates.

The general AWRM regulations also allow for the use of replacement plans to offset the depletions caused by out-of-priority water use. The development, review, and approval of replacement plans will be based on a generalized hydrologic analysis developed by the State Engineer.

The general AWRM regulations were unsuccessfully challenged in court in *Tri-State Generation and Transmission Ass'n, Inc. v. D'Antonio,* 2012-NMSC-039. In this case, the New Mexico Supreme Court analyzed whether Section 72–2–9.1 provided the State Engineer with the authority to adopt regulations allowing it to administer water rights according to interim priority determinations developed by the NMOSE.

In *Tri-State* the Court held that (1) the Legislature delegated lawful authority to the State Engineer to promulgate the AWRM regulations, and (2) the regulations are not unconstitutional on separation of powers, due process, or vagueness grounds. Specifically, the Court found that establishing such regulations does not violate the constitutional separation of powers because AWRM regulations do not go beyond the broad powers vested in the State Engineer, including the authority vested by Section 72–2–9.1. The Court further found that the AWRM regulations did not violate the separation of powers between the executive and the judiciary despite the fact that the regulations allow priorities to be administered prior to an *inter se* adjudication of priority. Rather, the Legislature chose to grant quasi-judicial authority in administering priorities prior to final adjudication to the NMOSE, which was well within its discretion to do.

The Court further held that the AWRM regulations do not violate constitutional due process because they do not deprive the party challenging the regulations of a property right. As explained by the Court, a water right is a limited, usufructuary right providing only a right to use a certain amount of water established through beneficial use. As such, based on the long-standing principle that a water right entitles its holder to the use of water according to priority, regulation of that use by the State does not amount to a deprivation of a property right.

In addition to *Tri-State*, several cases that address other aspects of the regulatory powers of the NMOSE have been decided recently. Priority administration was addressed in a case concerning the 2003 settlement agreement entered into by the United States, New Mexico (State), the Carlsbad Irrigation District (CID), and the Pecos Valley Artesian Conservancy District (PVACD) related to the use of the waters of the Pecos River. *State ex rel. Office of the State Engineer v. Lewis*, 2007-NMCA-008, 140 N.M. 1. The issues in the case revolved around (1) the competing claims of downstream, senior surface water users in the Carlsbad area and upstream, junior groundwater users in the Roswell Artesian Basin and (2) the competing claims of New Mexico and Texas users. Through the settlement agreement, the parties sought to resolve these issues through public funding, without offending the doctrine of prior appropriation and without resorting to a priority call. The settlement agreement was, in essence, a water conservation plan designed to augment the surface flows of the lower Pecos River in order to (1) secure the delivery of water within the CID, (2) meet the State's obligations to Texas under the 1948 Pecos River Compact (Compact) and the 1988 United States Supreme Court Decree, and (3) limit the circumstances under which the United States and CID would be entitled to make a call for the administration of water right priorities. The agreement included the development of a well field to facilitate the physical delivery of groundwater directly into the Pecos River under certain conditions, the purchase and transfer to the well field of existing groundwater rights in the Roswell UWB by the State, and the purchase and retirement of irrigated land within PVACD and CID.

The Court of Appeals framed the issue as whether the priority call procedure is the exclusive means under the doctrine of prior appropriation to resolve existing and projected future water shortage issues. The Court held that Article XVI, Section 2 of the Constitution, which states that "[p]riority of appropriation shall give the better right," and Article IX of the Compact, which states that "[i]n maintaining the flows at the New Mexico-Texas state line required by this compact, New Mexico shall in all instances apply the principle of prior appropriation within New Mexico," do not require a priority call as the sole response to water shortage concerns. The Court found it reasonable to construe these provisions to permit flexibility within the prior appropriation doctrine in attempting to resolve longstanding water issues. Thus, the more flexible approach pursued by the settling parties through the settlement agreement was not ruled out in the Constitution, the Compact, or case precedent.

In relation to the NMOSE's regulatory authority over supplemental wells, in *Herrington v. State of New Mexico ex rel. State Engineer,* 2006-NMSC-014, 139 N.M. 368, the New Mexico Supreme Court clarified certain aspects of the *Templeton* doctrine. The *Templeton* doctrine allows senior surface water appropriators impaired by junior wells to drill a supplemental well to offset the impact to their water right. *See Templeton v. Pecos Valley Artesian Conservancy District,* 1958-NMSC-131, 65 N.M. 59. According to *Templeton,* drilling the supplemental well allows the senior surface right owner to keep their surface water right whole by drawing upon groundwater that originally fed the surface water supply. Although the New Mexico prior appropriation doctrine theoretically does not allow for sharing of water shortages, the *Templeton* doctrine permits both the aggrieved senior surface appropriator and the junior user to divert their full share of water. The requirements for a successful *Templeton* supplemental well include (1) a valid surface water right, (2) surface water fed in part by groundwater (baseflow), (3) junior appropriators intercepting that groundwater by pumping, and (4) a proposed well that taps the same groundwater source of the applicant's original appropriation.

In *Herrington* the Court clarified that the well at issue would meet the *Templeton* requirements if it was dug into the same aquifer that fed the surface water. The Court also clarified whether a *Templeton* well could be drilled upstream of the surface point of diversion. The Court determined that the proper placement of a *Templeton* well must be considered on a case-by-case basis, and that these supplemental wells are not necessarily required to be upstream in all cases.

Lastly, the Court addressed the difference between a *Templeton* supplemental well and a statutory supplemental well drilled under NMSA 1978, Sections 72–5–23, -24 (1985). The Court found that a statutory transfer must occur within a continuous hydrologic unit, which differs from the narrow *Templeton* same-source requirement. Although surface to groundwater transfers require a hydrologic connection, this may be a more general determination than the *Templeton* baseflow source requirement. Further, *Templeton* supplemental wells service the original parcel, while statutory transfers may apply to new uses of the water, over significant distances.

Also related to the NMOSE's regulatory authority, the Court of Appeals addressed unperfected water rights in *Hanson v. Turney*, 2004-NMCA-069, 136 N.M. 1. In *Hanson*, a water rights permit holder who had not yet applied the water to beneficial use sought to transfer her unperfected water right from irrigation to subdivision use. The State Engineer denied the application because the water had not been put to beneficial use. The permit holder argued that pursuant to NMSA 1978, Section 72-12-7(A) (1985), which allows the owner of a "water right" to change the use of the water upon application to the State Engineer, the State Engineer had wrongly rejected her application. The Court upheld the denial of the application, finding that under western water law the term "water right" does not include a permit to appropriate water when no water has been put to beneficial use. Accordingly, as used in Section 72-12-7(A) the term "water right" requires the perfection of a water right through beneficial use before a transfer can be allowed.

4.1.1.3 Legal Review of NMOSE Determinations

In *Lion's Gate Water v. D'Antonio*, 2009-NMSC-057, 147 N.M. 523, the Supreme Court addressed the scope of the district court's review of the State Engineer's determination that no water is available for appropriation. In *Lion's Gate*, the applicant filed a water rights application, which the State Engineer rejected without publishing notice of the application or holding a hearing, finding that no water was available for appropriation. The rejected application was subsequently reviewed in an administrative proceeding before the State Engineer's hearing examiner. The hearing examiner upheld the State Engineer's decision on the grounds that there was no unappropriated water available for appropriation.

This ruling was appealed to the district court, which determined that it had jurisdiction to hear all matters either presented or that might have been presented to the State Engineer, as well as new evidence developed since the administrative hearing. The NMOSE disagreed, arguing that only the issue of whether there was water available for appropriation was properly before the district court. The Supreme Court agreed with the NMOSE. The Court found that the comprehensive nature of the water code's administrative process, its mandate that a hearing must be held prior to any appeal to district court, and the broad powers granted to the State Engineer clearly express the Legislature's intent that the water code provide a complete and exclusive means to acquire water rights. Accordingly, the NMOSE was correct that the district court's *de novo* review of the application was limited to what the State Engineer had already addressed administratively, in this case whether unappropriated water was available.

The Court also held that the water code does not require publication of an application for a permit to appropriate if the State Engineer determines no water is available for appropriation, because no third-party rights are implicated unless water is available. If water is deemed to be available, the State Engineer must order notice by publication in the appropriate form.

Based in large part on the holding in *Lion's Gate*, the New Mexico Court of Appeals in *Headon v. D'Antonio*, 2011-NMCA-058, 149 N.M. 667, held that a water rights applicant is required to proceed through the administrative process when challenging a decision of the State Engineer. In *Headon* the applicant challenged the NMOSE's determination that his water rights were forfeited. To do so, he filed a petition seeking declaratory judgment as to the validity of his water rights in district court, circumventing the NMOSE administrative hearing process. 2011-NMCA-058, ¶¶ 2-3. The Court held that the applicant must proceed with the administrative hearing, along with its *de novo* review in district court, to challenge the findings of the NMOSE.

Legal review of NMOSE determinations was also an issue in *D'Antonio v. Garcia*, 2008-NMCA-139,145 N.M. 95, where the Court of Appeals made several findings related to NMOSE administrative review of water rights matters. *Garcia* involved an NMOSE petition to the district court for enforcement of a compliance order after the NMOSE hearing examiner had granted a motion for summary judgment affirming the compliance order. 2008-NMCA-139, ¶¶ 2-5. The Court first found that the right to a hearing granted in NMSA 1978, § 72-2-16 (1973), did not create an absolute right to an administrative hearing. Rather, the NMOSE hearing contemplated in Section 72-2-16 could be waived if a party did not timely request such a hearing. *Id*. ¶ 9. In *Garcia* the defendant had not made such a timely request and therefore was not entitled to a full administrative hearing prior to issuance of an order by the district court.

The Court also examined the regulatory powers of the NMOSE hearings examiner, specifically, whether 19.25.2.32 NMAC allows the hearing examiner to issue a final order without the express written consent of the State Engineer. *Id*. ¶¶ 11-15. The Court held that the regulation allowed the hearing examiner to dismiss a case without the express approval of the State Engineer. *Id*. ¶ 14. Finally, the Court held that the NMOSE hearing examiner may dismiss a case without full hearing when a party willfully fails to comply with the hearing examiner's orders. *Id*. ¶¶ 17-18. Accordingly, the Court in *Garcia* upheld the NMOSE hearing examiner's action to issue a compliance order without a full administrative hearing or final approval by the State Engineer. As such, the district court had the authority to enforce that compliance order.

4.1.1.4 Beneficial Use of Water – Non-Consumptive Use

Carangelo v. Albuquerque-Bernalillo County Water Utility Authority, 2014-NMCA-032, addressed whether a non-consumptive use of water qualifies as a beneficial use under New Mexico law and, accordingly, can be the basis for an appropriation of such water. In *Carangelo*, the NMOSE granted the Albuquerque-Bernalillo County Water Utility Authority's (Authority's) application to divert approximately 45,000 acre-feet per year of Rio Grande surface water, to which the Authority had no appropriative right. The Authority intended to use the water for the non-consumptive purpose of "carrying" the Authority's own San Juan-Chama Project water, Colorado River Basin water to which the Authority had contracted for use of, to a water treatment plant for drinking water purposes. The Court of Appeals found the NMOSE erred in granting the application because the application failed to seek a new appropriation. The Authority's application sought to divert water, to which the Authority asserted no prior appropriative right, which required a new appropriation. Moreover, the Authority affirmatively asserted no beneficial use of the water. The Court remanded the matter to the NMOSE to issue a corrected permit.

The Court's decision included the following legal conclusions:

- A new non-consumptive use of surface water in a fully appropriated system requires a new appropriation of water. A "non-consumptive use" is a type of water use where either there is no diversion from a source body or there is no diminishment of the source. Neither the New Mexico Constitution nor statutes governing the appropriation of water distinguish between diversion of water for consumptive and non-consumptive uses. Because both can be beneficial uses, New Mexico's water law applies equally to either.

- The Authority did not need to file for a change in place or purpose of use for the diversion of its San Juan-Chama Project water. The Court stated that the San Juan-Chama Project water does not come from the Rio Grande Basin, and the Authority's entitlement to its beneficial use is not within the administrative scope of the Rio Grande Basin. Accordingly, the Authority already had an appropriative right to that water and did not need to file an application with the NMOSE for its use.

4.1.1.5 Impairment

Montgomery v. Lomos Altos, Inc., 2007-NMSC-002, 141 N.M. 21, involved applications to transfer surface water rights to groundwater points of diversion in the fully appropriated Rio Grande stream system. In order for a transfer to be approved, an applicant must show, among other factors, that the transfer will not impair existing water uses at the move-to location. In *Lomos Altos*, several parties protested the NMOSE's granting of the applications, arguing that surface depletions at the move-to location caused by the applications should be considered *per se* impairment of existing rights. The Court found that questions of impairment are factual and cannot be decided as a matter of law, but must be determined on a case-by-case basis. In doing so, the Court held that surface depletions in a fully appropriated stream system do not result in *per se* impairment, but the Court noted that under some circumstances, even *de minimis* depletions can lead to a finding of impairment. The Court further found that in order to determine impairment, all existing water rights at the "move-to" location must be considered.

4.1.1.6 Deep, Non-Potable Aquifers

In 2009 the New Mexico Legislature amended NMSA 1978, Section 72-12-25 (2009), to provide for administrative regulation of deep, non-potable underground water basins. These underground water basins are greater than 2,500 feet deep and contain greater than 1,000 parts per million of total dissolved solid. Drilling wells into such basins had previously been unregulated. The amendment requires the NMOSE to conduct hydrologic analysis on well drilling in these basins. The type of analysis required by the NMOSE depends on the use for the water.

4.1.1.7 Rights Appurtenant to Water Rights

The New Mexico Supreme Court has issued three recent opinions dealing with appurtenancy. *Hydro Resources Corp. v. Gray,* 2007-NMSC-061, 143 N.M. 142, involved a dispute over ownership of water rights developed by a mining lessee in connection with certain mining claims owned by the lessor. The Supreme Court held that under most circumstances, including mining, water rights are not considered appurtenant to land under a lease. The sole exception to the general rule that water rights are separate and distinct from the land is water used for irrigation. Therefore, a lessee can acquire water rights on leased land by appropriating water and placing it to beneficial use. Those developed rights remain the property of the lessee, not the lessor, unless stipulated otherwise in an agreement.

In a case examining whether irrigation water rights were conveyed with the sale of land or severed prior to the sale (*Turner v. Bassett,* 2005-NMSC-009, 137 N.M. 381), the Supreme Court examined New Mexico's transfer statute, NMSA 1978, Section 72-5-23 (1941), along with the NMOSE regulations addressing the change of place or purpose of use of a water right, 19.26.2.11(B) NMAC. The Court found that the statute, coupled with the applicable regulations and NMOSE practice, requires consent of the landowner and approval of the transfer application by the State Engineer for severance to occur. The issuance of a permit gives rise to a presumption that the water rights are no longer appurtenant to the land. A landowner who holds water rights and follows the statutory and administrative procedures to effect a severance and initiate a transfer may convey the land severed from its former water rights, without necessarily reserving those water rights in the conveyance documents.

In *Walker v. United States,* 2007-NMSC-038, 142 N.M. 45, the New Mexico Supreme Court examined the issue of whether a water right includes an implicit right to graze. After the U.S. Forest Service canceled the Walkers' grazing permits, the Walkers filed a complaint arguing that the United States had taken their property without just compensation in violation of the Fifth Amendment to the United States Constitution. The Walkers asserted a property right to the allotments under New Mexico state law. Specifically, the Walkers argued that the revocation of the federal permit resulted in the loss of "water, forage, and grazing" rights based on New Mexico state law and deprived them of all economically viable use of their cattle ranch.

The Court found that a stock watering right does not include an appurtenant grazing right. In doing so, the Court addressed in depth the long understood principle in western water law that water rights, unless utilized for irrigation, are not appurtenant to the land on which they are used. The Court also clarified that the beneficial use for which a water right is established does not guarantee the water right owner an interminable right to continue that same beneficial use. The Walkers could have transferred their water right to another location or another use if they could not continue with the original uses. For these reasons, the Court rejected the Walkers attempt to make an interest in land incident or appurtenant to a water right.

4.1.1.8 Domestic Wells

New Mexico courts have recently decided several significant cases addressing domestic well permitting, and the NMOSE also recently amended its regulations governing domestic wells.

In *Bounds v. State ex. rel D'Antonio,* 2013-NMSC-037, the New Mexico Supreme Court upheld the constitutionality of New Mexico's Domestic Well Statute (DWS), NMSA 1978, Section 72-12–1.1 (2003). Bounds, a rancher and farmer in the fully appropriated and adjudicated Mimbres basin, and the New Mexico Farm and Livestock Bureau (Petitioners), argued that the DWS was facially unconstitutional. The DWS states that the NMOSE "shall issue" domestic well permits, without determining the availability of unappropriated water or providing other water rights owners in the area the ability to protest the well. The Petitioners argued that this practice violated the New Mexico constitutional doctrine of prior appropriation to the detriment of senior water users, as well as due process of law. The Court held that the DWS does not violate the doctrine of prior appropriation set forth in the New Mexico Constitution. The Court also held that Petitioners failed to adequately demonstrate any violation of their due process rights.

In addressing the facial constitutional challenge, the Court rejected the Petitioners' argument that the New Mexico Constitution mandates that the statutory requirements of notice, opportunity to be heard, and a prior determination of unappropriated waters or lack of impairment be applied to the domestic well application and permitting process. The Court reasoned that the DWS creates a different and more expedient permitting procedure for domestic wells and the constitution does not require a particular permitting process, or identical permitting procedures, for all appropriations. While holding that the DWS was valid in not requiring the same notice, protest, and water availability requirements as other water rights applications, the court confirmed that domestic well permits can be administered in the same way as all other water rights. In other words, domestic wells do not require the same rigors as other water rights when permitted but, when domestic wells are administered, constitutionally mandated priority administration still applies. Thus the DWS, which deals solely with permitting and not with administration, does not conflict with the priority administration provisions of the New Mexico Constitution.

The Court also found that the Petitioners failed to prove a due process violation because they did not demonstrate how the DWS deprived them of their water rights. Specifically, Bounds failed to show any actual impairment, or imminent future impairment, of his water rights. Bounds asserted that any new appropriations must necessarily cause impairment in a closed and fully appropriated basin, and therefore, granting any domestic well permit had the potential to impair his rights. The Court rejected this argument, finding that impairment must be proven using scientific analysis, not simply conclusory statements based on a bright line rule that impairment always occurs when new water rights are permitted in fully appropriated basins.

Two other significant domestic well decisions addressed domestic well use within municipalities. In *Smith v. City of Santa Fe*, 2007-NMSC-055, 142 N.M. 786, the Supreme Court examined the authority of the City of Santa Fe to enact an ordinance restricting the drilling of domestic wells. The Court held that under the City's home rule powers, it had authority to prohibit the drilling of a domestic well within the municipal boundaries and that this authority was not preempted by existing state law.

Then in *Stennis v. City of Santa Fe,* 2008-NMSC-008, 143 N.M. 320, Santa Fe's domestic well ordinance was tested when a homeowner (Stennis) applied for a domestic well permit with the NMOSE, but did not apply for a permit from the City. In examining the statute allowing municipalities to restrict the drilling of domestic wells, the Court found that municipalities must strictly comply with NMSA 1978, Section 3–53–1.1(D) (2001), which requires cities to file their ordinances restricting the drilling of domestic water wells with the NMOSE. On remand, the Court of Appeals held that Section 3-53-1.1(D) does not allow for *substantial* compliance. *Stennis v. City of Santa Fe*, 2010-NMCA-108, 149 N.M. 92. Rather, strict compliance is required and the City must have actually filed a copy of the ordinance with the NMOSE.

In addition to the cases addressing domestic wells, the regulations governing the use of groundwater for domestic use were substantially amended in 2006 to clarify domestic well use pursuant to NMSA 1978, Section 72-12-1.1. *See* 19.27.5.1 et seq. NMAC. The regulations:

1. Limit the amount of water that can be used pursuant to a domestic well permit to:

    - 1.0 acre-feet per year (ac-ft/yr) for a single household use (can be increased to up to 3.0 ac-ft/yr if the applicant can show that the combined diversion from domestic wells will not impair existing water rights).

    - 1.0 ac-ft/yr for each household served by a well serving more than one household, with a cap of 3.0 ac-ft/yr if the well serves three or more households.

    - 1.0 ac-ft/yr for drinking and sanitary purposes incidental to the operations of a governmental, commercial, or non-profit facility as long as no other water source is available. The amount of water so permitted is subject to further limitations imposed by a court or a municipal or county ordinance.

    The amount of water that can be diverted from a domestic well can also be increased by transferring an existing water right to the well. 19.27.5.9 NMAC.

2. Require mandatory metering of all new domestic wells under certain conditions, such as when wells are permitted within a domestic well management area, when a court imposes a metering requirement, when the water use is incidental to the operations of a governmental, commercial, or non-profit facility, and when the well serves multiple households. 19.27.5.13(C) NMAC.

3. Allow for the declaration of domestic well management areas when hydrologic conditions require added protections to prevent impairment to valid, existing surface water rights. In such areas, the maximum diversion from a new domestic well cannot exceed, and may be less than, 0.25 ac-ft/yr for a single household and up to 3.0 ac-ft/yr for a multiple household well, with each household limited to 0.25 ac-ft/yr. The State Engineer has not declared any domestic well management areas in the planning region.

4.1.1.9 Water Project Financing

The Water Project Finance Act, Chapter 72, Article 4A NMSA 1978, outlines different mechanisms for funding water projects in water planning regions. The purpose of the Act is to provide for water use efficiency, resource conservation, and the protection, fair distribution, and allocation of New Mexico's scarce water resources for beneficial purposes of use within the state. The Water Project Finance Act creates two funds: the Water Project Fund, NMSA 1978, Section 72-4A-9 (2005), and the Acequia Project Fund, NMSA 1978, Section 72-4A-9.1 (2004). Both funds are administered by the New Mexico Finance Authority. The Water Trust Board recommends projects to the Legislature to be funded from the Water Project Fund.

The Water Project Fund may be used to make loans or grants to qualified entities (broadly defined to include public entities and Indian tribes and pueblos). To qualify for funding, the project must be approved by the Water Trust Board for one of the following purposes: (1) storage, conveyance or delivery of water to end users, (2) implementation of federal Endangered Species Act of 1973 collaborative programs, (3) restoration and management of watersheds, (4) flood prevention, or (5) water conservation or recycling, treatment, or reuse of water as provided by law. NMSA 1978, § 72-4A-5(B) (2011). The Water Trust Board must give priority to projects that (1) have been identified as being urgent to meet the needs of a regional water planning area that has a completed regional water plan accepted by the NMISC, (2) have matching contributions from federal or local funding sources, and (3) have obtained all requisite state and federal permits and authorizations necessary to initiate the project. NMSA 1978, § 72-4A-5 (2011).

The Acequia Project Fund may be used to make grants to acequias for any project approved by the Legislature.

The Water Project Finance Act directed the Water Trust Board to adopt regulations governing the terms and conditions of grants and loans recommended by the Board for appropriation by the Legislature from the Water Project Fund. The Board promulgated implementing regulations in 2008. 19.25.10.1 et seq. NMAC. The regulations set forth the procedures to be followed by the Board and New Mexico Finance Authority for identifying projects to recommend to the Legislature for funding. The regulations also require that financial assistance be made only to entities that agree to certain conditions set forth in the regulations.

4.1.1.10 The Strategic Water Reserve

In 2005, the New Mexico Legislature enacted legislation to establish a Strategic Water Reserve, NMSA 1978, Section 72-14-3.3 (2007). Regulations implementing the Strategic Water Reserve statute were also implemented in 2005. 19.25.14.1 et seq. NMAC.

The statute authorizes the NMISC to acquire water rights or storage rights to compose the reserve. Section 72-14-3.3(A). Water in the Strategic Water Reserve can be used for two purposes: (1) to comply with interstate stream compacts and (2) to manage water for the benefit of endangered or threatened species or to avoid additional listing of species. Section 72-14-3.3(B). The NMISC may only acquire water rights that have sufficient seniority and consistent, historical beneficial use to effectively contribute to the purpose of the Reserve. The NMISC must annually develop river reach or groundwater basin priorities for the acquisition of water rights for the Strategic Water Reserve. The Pecos River has been designated as a priority basin.

4.1.1.11 Ditch and Acequia Water Use

Two recent cases by New Mexico courts address the issue of acequia water use. *Storm Ditch v. D'Antonio,* 2011-NMCA-104, 150 N.M. 590, examined the process for transferring a landowner's water rights from a community acequia to a municipality. The Court found that actual notice of the transfer application to the acequia was not mandated by statute; instead, publication of the landowner's transfer application provided sufficient notice to the acequia to inform it of the proposed transfer. Further, the statute requiring that the transfer applicant file an affidavit stating that no rules or bylaws for a transfer approval had been adopted by the acequia was not intended to prove notice. Rather, the statute was directed at providing the State Engineer with assurance that the applicant had met all requirements imposed by acequia bylaws before action was taken on the application, not in providing notice.

Pena Blanca Partnership v. San Jose Community Ditch, 2009-NMCA-016, 145 N.M. 555, involved attempts to transfer water rights from agricultural uses appurtenant to lands served by two acequias to non-agricultural uses away from the acequias. The acequias denied the water rights owners' (Owners) requests to make these changes pursuant to their authority under NMSA 1978, Section 73-2-21(E) (2003). The Owners appealed the acequias decision to district court. On appeal, the standard of review listed in Section 73–2–21(E) only allowed reversal of the acequia commissioners if the court found they had acted fraudulently, arbitrarily or capriciously, or not in accordance with law.

The Owners challenged this deferential standard of review in the Court of Appeals based on two grounds. First, the Owners argued that the *de novo* review standard in Article XVI, Section 5 of the New Mexico Constitution applied to the proposed transfers at issue, not the more deferential standard found in Section 73-2-21(E). The Court disagreed and found that the legislature provided for another review procedure for the decisions of acequia commissioners by enacting Section 73–2–21(E).

The Owners second assertion was that the deferential standard of review in Section 73-2-21(E) violated the equal protection clause of Article II, Section 18 of the New Mexico Constitution. The Owners argued that their equal protection guarantees were violated because water rights transfers out of acequias were treated differently than other water rights transfers. The court again disagreed, finding that although other determinations of water rights are afforded a *de novo* hearing in the district court, since the Owners still had access to the courts and the right of appeal, there were no equal protection violations.

4.1.1.12 Water Conservation

Guidelines for drafting and implementing water conservation plans are set forth in NMSA 1978, Section 72-14-3.2 (2003). By statute, neither the Water Trust Board nor the New Mexico Finance Authority may accept an application from a covered entity (defined as municipalities, counties, and any other entities that supply at least 500 acre-feet per annum of water to its customers, but excluding tribes and pueblos) for financial assistance to construct any water diversion, storage, conveyance, water treatment, or wastewater treatment facility unless the entity includes a copy of its water conservation plan.

The water conservation statute primarily supplies guidance to covered entities, as opposed to mandating any particular action. For example, the statute provides that the covered entity determines the manner in which it will develop, adopt, and implement a water conservation plan. The statute further states that a covered entity "shall consider" either adopting ordinances or codes to encourage conservation, or otherwise "shall consider" incentives to encourage voluntary compliance with conservation guidelines. The statute then states that covered entities "shall consider, and incorporate in its plan if appropriate, . . . a variety of conservation measures," including, in part, water-efficient fixtures and appliances, water reuse, leak repairs, and water rate structures encouraging efficiency and reuse. Section 72-14-3.2(D). Also, pursuant to NMSA 1978, §§ 72-5-28(G) (2002) and 72-12-8(D) (2002), when water rights are placed in a State Engineer-approved water conservation program, periods of nonuse of the rights covered in the plan do not count toward the four-year forfeiture period.

4.1.1.13 Municipal Condemnation

NMSA 1978, Section 3-27-2 (2009) was amended in 2009 to prohibit municipalities from condemning water sources used by, water stored for use by, or water rights owned or served by an acequia, community ditch, irrigation district, conservancy district, or political subdivision of the state.

4.1.1.14 Subdivision Act

The Subdivision Act, NMSA 1978, Section 47-6-11.2 (2013), was amended in 2013 to require proof of water availability prior to final approval of a subdivision plat. Specifically, the subdivider must present the county with (1) NMOSE-issued water use permits for the subdivision or (2) proof that the development will hook up to a water provider along with an opinion from the State Engineer that the subdivider can fulfill the water use requirements of the Subdivision Act. Previously the county had discretion to approve subdivision plats without such proof that the water rights needed for the subdivision were readily available. These water use requirements apply to all subdivisions of ten or more lots. The Act was also amended to prohibit approval of a subdivision permit if the water source for the subdivision is domestic wells.

4.1.2 State Water Laws and Administrative Policies Affecting the Region

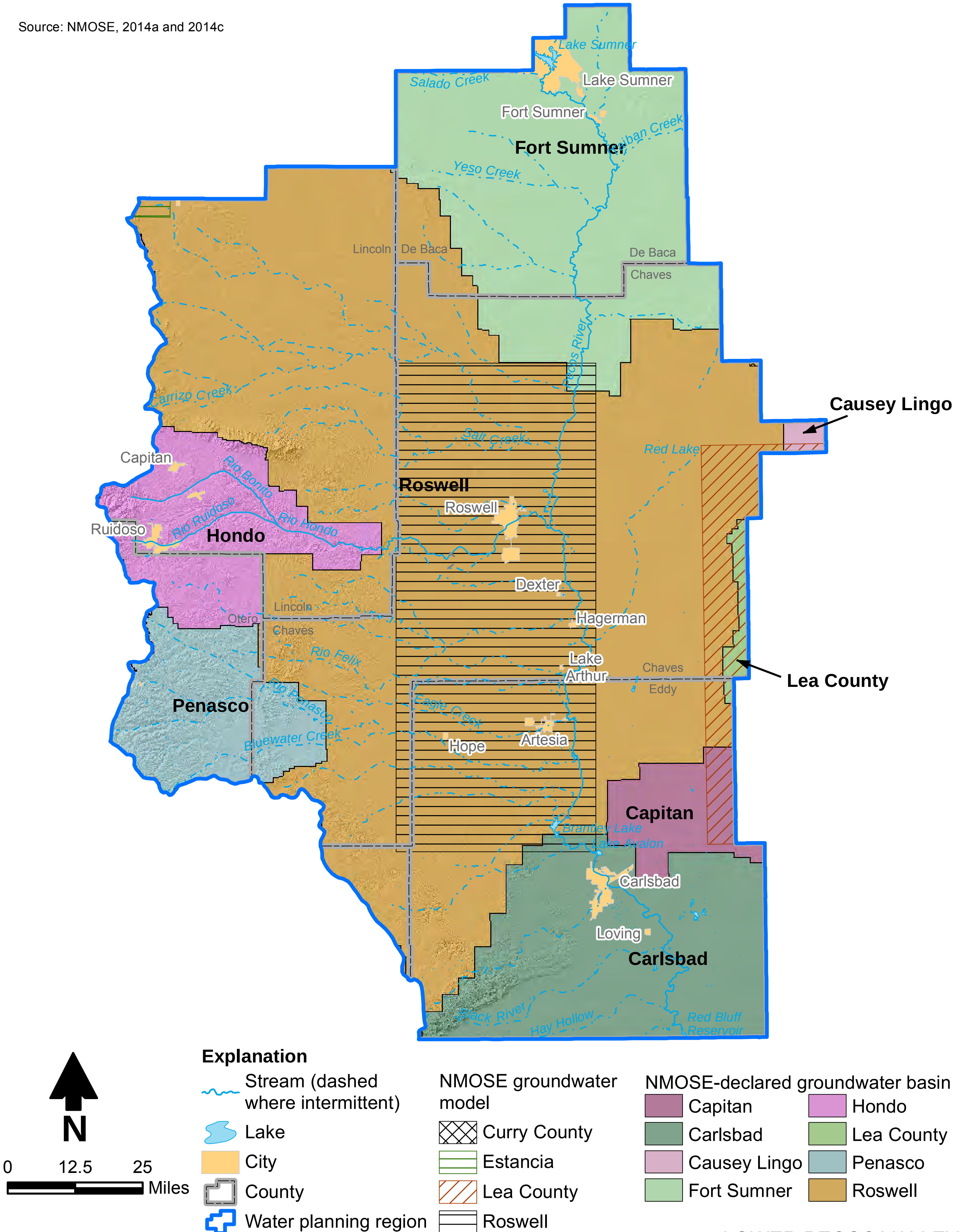
In New Mexico, water is administered by the State Engineer, who has the "general supervision of waters of the state and of the measurement, appropriation, distribution thereof and such other duties as required." NMSA 1978, § 72-2-1 (1982). To administer water throughout the state the State Engineer has several tools at its disposal, including designation of water masters, declaration of UWBs, and use of the AWRM rules, all of which are discussed below, along with other tools used to manage water within regions.

4.1.2.1 Water Masters

The State Engineer has the power to create water master districts or sub-districts by drainage area or stream system and to appoint water masters for such districts or sub-districts. NMSA 1978, § 72-3-1 (1919). Water masters have the power to apportion the waters in the water master's district under the general supervision of the State Engineer and to appropriate, regulate, and control the waters of the district to prevent waste. NMSA 1978, § 72-3-2 (2007). In 2006, the State Engineer created the Lower Pecos River Basin Water Master District (the District) for administration of surface and groundwater in the region. State Engineer Order 174. Along with creation of the District, Order 174 also created the Fort Sumner, Carlsbad, and Roswell Artesian Basin sub-districts, all of which the water master for the District supervises. The Rio Hondo sub-district, formed in 2004, also falls under the supervision of the water master. While the water master for the District is an employee of the NMOSE, pursuant to Order 174 the salary and expenses of the water master are to be paid by the water rights owners in the region through the boards of county commissioners of De Baca, Chavez, Eddy, Quay, Lincoln, and Otero counties. The water master for the Roswell Artesian Basin sub-district is also paid from county assessments. The water masters in the region are:

- Carlsbad Water Master
- Pecos River Water Master
- Rio Hondo Water Master
- Rio Peñasco Water Master
- Roswell/Artesian Water Master

Source: NMOSE, 2014a and 2014c



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

NMOSE-Declared Groundwater Basins and Groundwater Models

Figure 4-1

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4.1.2.2 Groundwater Basin Guidelines

As set forth below, basin guidelines have been formally adopted for several underground water basins (UWBs) within the planning region (Figure 4-1). These UWBs are discussed in depth in the 2001 RWP, Section IV. Recent actions by the State Engineer regarding the UWBs in the planning region include:

- *Fort Sumner UWB:* State Engineer Order No. 183 requires meters to be installed on all irrigation, municipal, and industrial wells before January 1, 2014. Requirements for Metering Groundwater in the Ft. Sumner Underground Water Basin of the Lower Pecos River Basin, May 23, 2013.

- *Lea County UWB:* In 2005 the Lea County UWB was extended by an order of the State Engineer. State Engineer Order 166, September 23, 2005. In 2009, the State Engineer closed the High Plains aquifer within the limits of the Lea County UWB to applications for new water appropriations. State Engineer Order, September 14, 2009. The review of water right applications is governed by the *Lea County Underground Water Basin Guidelines for Review of Water Right Applications* (NMOSE, 2014e), which were issued to replace the administrative procedures adopted in the 1950s. The guidelines set forth the review procedures for applications proposing to divert from the High Plains aquifer, the primary water supply source in the Lea County UWB. Under the guidelines, all applications for new water appropriations from the High Plains aquifer will be denied by the State Engineer. The guidelines define the criteria for designating critical management areas and prohibit any applications for appropriation within such areas. The guidelines also mandate the metering of non-domestic and livestock water wells.

- *Roswell UWB:* In 2005, the State Engineer issued the *Roswell Basin Guidelines for Review of Water Right Applications* (NMOSE, 2005). The guidelines set forth general procedures for processing water rights applications within the Roswell UWB. Under the guidelines, the following applications will be denied: those to appropriate groundwater within areas closed to such appropriations, those to appropriate surface water, and those to increase diversions from a critical management area. The guidelines define the criteria for designating critical management areas and mandate the metering of non-domestic and livestock water wells.

4.1.2.3 AWRM Implementation in the Basin

Although the Lower Pecos River Basin has been designated a priority basin for Active Resource Water Management, AWRM regulations have not yet been issued for the basin.

4.1.2.4 Special Districts in the Basin

Special districts are discussed at length in the 2001 RWP, Section V. Special districts are various districts within the region having legal control over the use of water in that district. All are subject to specific statutes or other laws concerning their organization and operation, found in Chapter 73 of the New Mexico Statutes.

In the region several soil and water conservation districts (SWCDs) as well as drainage districts exist. The special districts with the most influence on water use in the Lower Pecos Valley region are:

- Fort Sumner Irrigation District
- Pecos Valley Artesian Conservancy District
- Carlsbad Irrigation District.

4.1.2.5 State Court Adjudications in the Basin

The Pecos River adjudication is still ongoing in the planning region. Adjudication work is also ongoing or pending for the Roswell UWB, Pecos River Surface Water, and Hondo Stream System and UWB sections, described more in depth below. Litigation is also pending in the City of Las Vegas proceeding, which is currently pending in the district court. According to the New Mexico Office of the State Engineer/Interstate Stream Commission FY 2015 Rule 71.3 Report for the Pecos Adjudication Bureau (June 9, 2015) and personal communications with NMOSE staff, the current status of the portion of the Pecos River stream system applicable to the region is as follows:

- *Roswell Underground Water Basin:* Readjudication of relation-back claims.
- *Carlsbad Irrigation District:* Section *inter se* and partial final decree.
- *Hondo Stream System and Underground Water Basin:* Majority of surface and groundwater claims adjudicated. Still ongoing.
- *Fort Sumner Irrigation District:* Determination of irrigation water requirements.
- *Carlsbad UWB, Black River, Peñasco UWB, Pecos miscellaneous:* Hydrographic surveys not conducted.

The 2001 RWP, Section V and Appendices G and H further discuss adjudications in the Pecos River stream system.

4.1.2.6 State Court Decrees

The following court decrees apportion water in the Lower Pecos Valley planning region:

- *State of New Mexico ex rel. State Engineer v. Lewis,* Cause No. 20294 and 22600 Consolidated (Hondo Basin Decree).

- *State of New Mexico ex rel. State Engineer v. Lewis* (Partial Final Decree (1967)).
- *State of New Mexico ex rel. State Engineer v. Lewis*, Cause No. 20294 and 22600 (Partial Final Decree (2003)) among CID, PVACD, the NMOSE, the NMISC, the U.S. Bureau of Reclamation (USBR), and the United States adopting the Settlement Agreement among the parties.
- *State ex rel. Office of the State Engineer v. Lewis,* 2007-NMCA-008. The court affirmed the March 25, 2003 Partial Final Decree and, accordingly, the March 25, 2003 Agreement among the NMOSE, the NMISC, and the Fort Sumner Irrigation District.

4.1.3 Federal Water Laws

The law of water appropriation has been developed primarily through decisions made by state courts. Since the region's accepted plan was published in 2001 several federal cases have been decided examining various water law questions. These cases are too voluminous to include here, and many of the issues in the cases will not apply directly to the region. However, New Mexico is a party to one original jurisdiction case in the U.S. Supreme Court involving the Rio Grande Compact and waters of the Lower Rio Grande. Because of its importance to the entire state it is included here.

In *Texas v. New Mexico and Colorado*, No. 141 Original (U.S. Supreme Court, 2014), Texas alleges that New Mexico has violated the Rio Grande Compact by intercepting water Texas is entitled to under the Compact through groundwater pumping and surface diversions downstream of Elephant Butte Reservoir but upstream of the New Mexico-Texas state line. Colorado is also a defendant in the lawsuit as it is a signatory to the Rio Grande Compact. The United States has intervened as a Plaintiff in the case. Elephant Butte Irrigation District and El Paso County Water Improvement District Number One have both sought to intervene in the case as well, claiming that their interests are not fully represented by the named parties. The motions to intervene along with a motion to dismiss filed by New Mexico are currently pending.

4.1.3.1 Federal Reservations

The doctrine of federally reserved water rights was developed over the course of the 20th Century. Simply stated, federally reserved rights are created when the United States sets aside land for specific purposes, thereby withdrawing the land from the general public domain. In doing so, there is an implied, if not expressed, intent to reserve an amount of water necessary to fulfill the purpose for which the land was set aside. Federally reserved water rights are not created, or limited, by state law.

Federally reserved water rights on Indian lands are known as "*Winters* reserved rights." The *Winters Doctrine* provides that at the time the United States established an Indian reservation, it also reserved sufficient water to provide for the reservation as a permanent homeland. *Winters v.*

United States, 207 U.S. 564 (1908). Neither the priority date nor the amount of *Winters* reserved rights is based on the historical actual beneficial use of water. Under the *Winters Doctrine*, the priority date is based on the date the federal government established the Indian reservation. A *Winters* reserved right is quantified based on the amount of water needed to make the reservation a permanent homeland and to fulfill the purposes of the reservation. In 1963, the United States Supreme Court adopted the "practically irrigable acreage" standard for quantifying federal Indian reserved water rights through a determination of the number of acres that can be practically or feasibly irrigated on the reservation. *Arizona v. California,* 376 U.S. 546 (1963). In New Mexico, courts have faced a different question in the determination of Pueblo Indian water rights. Although one federal district court recognized historically irrigated acreage as the basis for determining the quantity of a pueblo's water right, there is no established law for determining Pueblo Indian water rights. *See New Mexico ex rel. State Engineer v. Aamodt, et al.*, 6:6-CV-6639 (D.N.M.).

Federally reserved lands within the Lower Pecos Valley planning region include the following:

- Mescalero Apache Reservation
- Carlsbad Caverns National Park
- Lincoln National Forest
- Bitter Lake National Wildlife Refuge
- Bureau of Land Management lands

4.1.3.2 Interstate Stream Compacts

Interstate compacts become federal law once ratified by Congress. The 1948 Pecos River Compact governs water use on the Pecos River. Information regarding this compact is provided in the 2001 RWP, Section V.

4.1.3.3 Treaties

Not applicable.

4.1.3.4 Federal Water Projects

The Pecos River Basin Water Salvage Project is a USBR-funded project to control salt cedar growth from the Sumner Dam area to the New Mexico-Texas state line. Four major dams are located within this reach of the Pecos River: Sumner Dam, Brantley Dam, Avalon Dam, and Red Bluff Dam. This project has not been funded for several years at the date of publication of this report.

The Carlsbad Project is in southeastern New Mexico near Fort Sumner and Carlsbad. The Carlsbad Project stores water in Santa Rosa (an Army Corps of Engineers dam), Sumner, Brantley, and Avalon dams to provide water for about 25,000 acres within the CID. Project features include Sumner Dam and Lake Sumner (formerly Alamogordo Dam and Reservoir), McMillan Dam (breached in 1991 and replaced with Brantley Dam), Avalon Dam, and a drainage and distribution system to irrigate 25,055 acres of land in the Carlsbad area.

4.1.3.5 Federal Adjudications in the Basin

See Section 4.1.2.5, listing all adjudications in the basin.

4.1.3.6 Federal Court Decrees in the Basin

The following decrees apportion water use in the Lower Pecos Valley region. All are also discussed in the 2001 RWP, Section V.

- The Hope Community Ditch Decree, Cause No. 712 Equity (May 8, 1933)
- The U.S. Supreme Court Amended Decree, *Texas v. New Mexico,* 485 U.S. 388 (March 28, 1988)
- The U.S. Supreme Court Amended Decree, *Texas v. New Mexico* (February 26, 1990)

4.1.4 Tribal Law

The Mescalero Apache Tribe has no code or ordinances relating to water use.

4.1.5 Local Law

Local laws addressing water use have been implemented by both municipalities and counties within the planning region.

4.1.5.1 De Baca County

De Baca County has no water ordinances or comprehensive plan.

4.1.5.2 Village of Fort Sumner

The Village of Fort Sumner has no water ordinances.

4.1.5.3 Lincoln County

Water use in Lincoln County is guided by the *Lincoln County Comprehensive Plan* (Sites Southwest, 2007) and regulated through ordinances and a resolution.

The *Lincoln County Comprehensive Plan* (August 2007) emphasizes water issues and outlines several County goals related to water, including securing a 100-year water supply, prohibiting the drilling of domestic wells on lands from which water rights have been sold, using reclaimed water, and imposing water conservation measures.

The Lincoln County Subdivision Ordinance 2013-2 (July 17, 2013) requires, among other things, that the developer of a new subdivision submit a water availability plan (§ 17.2), prepare an evaluation to demonstrate a 40-year supply of water (§ 17.3.1), place a limitation of 0.25 acre-feet per year maximum water use per lot (§ 17.3.1a), and meet minimum water quality requirements (§ 17.5). It further requires the submittal of a conservation plan that includes a water budget and lists water conservation measures, along with a preliminary plat (§ 18.1).

The Lincoln County Mining Ordinance 2009-01 requires a mining permit applicant to describe water used in connection with mining operations (§ 4.2(B)(14).

Lincoln County Resolution 2000-33 encourages landscaping practices to minimize water use.

4.1.5.4 Village of Ruidoso

Water use in the Village of Ruidoso is guided by its *2010 Comprehensive Plan* (Village of Ruidoso, 2010). Section IV of the comprehensive plan states that a major goal of the Village is to provide adequate water to residents and visitors, even during severe drought conditions.

The Ruidoso Code of Ordinances has a number of provisions relating to water regulation. The Code mandates water saving devices in new construction (§ 86-31(j)), prohibits the wasting of water (§ 86-32(b)(3)), restricts most outdoor water uses depending on drought conditions ranging from "normal" to "extreme" (§ 86-32(c)-(g)), and recommends other miscellaneous conservation measures (§ 86-32(i)).

The Village of Ruidoso has also completed a Conservation Plan and a Water Development Plan. Both are awaiting review by the NMOSE. To address water quality, the Village also has a source water protection plan.

4.1.5.5 Chaves County

Chaves County has no separate water ordinances, but provides guidance through the 2015 *Chaves County Comprehensive Plan* (Chaves County, 2015). Among the "themes" of the plan is the following statement: "Due to the amount of agriculture present in Chaves County, there is a strong need for the County to stay vigilant in preventing water contamination of the surface and groundwater supplies." Section 9 of the plan discusses water and wastewater issues and sets forth a number of policies currently being implemented to protect the quality and supply of the water resources in the County.

4.1.5.6 City of Roswell

Two ordinances regulate water use in the City of Roswell. Water Conservation Ordinance No. 05-08 prohibits wasting of water, and the Emergency Water Shortage Ordinance No. 0284 sets a procedure for water rationing in the event of water shortages.

4.1.5.7 Otero County

Otero County regulates subdivision water use through the Otero County Code. Chapter 200 of the code regulates the subdivision of land. It provides that for any new subdivision, the New Mexico State Engineer must determine whether there is sufficient water for the subdivision (§ 200-22(A)). Further, a subdivision can be approved only if there is an agreement with an existing community water system to provide water or a State Engineer permit allowing the appropriation of water (§ 200-22(B)).

4.1.5.8 Village of Cloudcroft

Water use in the Village of Cloudcroft is regulated through the Cloudcroft Village Code. The code prohibits the waste of water (§ 7-1A-7, 7-1A-9(D)), sets forth water conservation requirements (§ 7-1A-9(D)(4),(5)), restricts outdoor water use (§ 7-1A-9(D)(3)), and provides for additional restrictions during a water emergency (§ 7-1A-9(H)). It also mandates the metering of domestic wells (§ 7-1A-6). Further, the Village Code requires that for a new subdivision, the developer must transfer into the Village sufficient water rights to supply the subdivision—at least 0.45 acre-feet per annum for each lot—and the transfer must be approved by the State Engineer (or the developer must make a cash payment in lieu of water) (§ 10-3-5).

4.1.5.9 Eddy County

Water use in Eddy County is guided by the *Eddy County Comprehensive Plan* (Sites Southwest, 2008). Section 8(B) of the comprehensive plan sets forth three water resource goals: development of a county-wide water conservation plan, ensuring that new developments have a sufficient water supply, and regionalization of water systems in the County.

The Eddy County Subdivision Regulations, Ordinance O-13-76 (June 25, 2013) govern the development of new subdivisions, including water management. Under the regulations the developer of a subdivision must (1) demonstrate that there is water of sufficient quantity to fulfill the maximum annual water requirements for the subdivision, including water for indoor and outdoor domestic uses (§ 4.5.1(a)), (2) demonstrate that the water is of acceptable quality for human consumption (§ 4.5.1(b)), (3) submit a water supply plan, including conservation and water quality components (§ 4.5.2(a)), and (4) submit a State Engineer permit if the subdivision consists of 20 or more parcels, any one of which is 2 acres or less (§ 5.3.10). In addition, if the source of water for the subdivision is an existing municipal or community water system, the developer must prepare a water availability assessment (Appendix A-1, § 5).

4.1.5.10 City of Artesia

The City of Artesia has no separate water ordinances, but provides guidance through the *City of Artesia Comprehensive Plan Update 2012* (Sites Southwest and MolzenCorbin, 2008). Chapter 8 of the plan discusses water and wastewater issues and sets forth a number of goals and strategies to help guide the City in addressing existing vulnerabilities of its water systems. Goals discussed in the plan include expanding water system service, reducing the possibility of a deficiency in water rights, reducing the possibility of water supply interruptions, and preventing water quality problems.

4.1.5.11 City of Carlsbad

Water use in the City of Carlsbad is guided by the *Greater Carlsbad Comprehensive Plan: Strategy 2030* (Sites Southwest, 2012). Chapter 7(A)(4) of the comprehensive plan discusses water conservation measures, including voluntary measures for individuals and businesses, water rationing, and reuse of effluent from the wastewater treatment plant for watering the City park and golf course. The plan notes that the Carlsbad area has been in a period of prolonged drought, and that the City has responded by implementing several policies to conserve water and plan for drought. Chapter 7(C) of the plan sets forth several water goals, including providing adequate water supply, upgrading the city water system to support future growth, acquiring additional water rights as necessary and as they become available, and achieving a 10 percent reduction in water use through conservation over the next 10 years.

The Carlsbad, New Mexico Code of Ordinances includes the City's Water Conservation, Emergency Response and Drought Management Ordinance (§§ 52-171 to 52-178). The ordinance "encourages" a variety of voluntary conservation measures for individuals and businesses (§ 52-173), and it specifies water rationing measures for three stages of drought based on the aquifer level and chloride concentration in City wells (§§ 52-174 to 52-176).

4.2 Relevant Environmental Law

4.2.1 Species Protection Laws

4.2.1.1 Federal Endangered Species Act

The Endangered Species Act (ESA) can have a tremendous influence on the allocation of water, especially of stream and river flows. 16 U.S. C.§§ 1531 to 1544. The ESA was enacted in 1973 and, with limited exceptions, has remained in its current form since then. The goal of the Act is to protect threatened and endangered species and the habitat on which they depend. 16 U.S.C. § 1531(b). The Act's ultimate goal is to "recover" species so that they no longer need protection under the Act.

The ESA provides several mechanisms for accomplishing these goals. It authorizes the U.S. Fish and Wildlife Service (USFWS) to list "threatened" or "endangered" species, which are then protected under the Act, and to designate "critical habitat" for those species. The Act makes it unlawful for anyone to "take" a listed species unless an "incidental take" permit or statement is first obtained from the Department of the Interior. 16 U.S.C. §§ 1538, 1539. To "take" is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct." 16 U.S.C. § 1532(19).

In addition, federal agencies must use their authority to conserve listed species. 16 U.S.C. § 1536(a)(1). They must make sure, in consultation with USFWS, that their actions do not jeopardize the continued existence of listed species or destroy or harm habitat that has been designated as critical for such species. 16 U.S.C. § 1536(a)(2). This requirement applies whenever a private or public entity undertakes an action that is "authorized, funded, or carried out," wholly or in part by a federal agency. *Id.* As part of the consultation process, federal agencies must usually prepare a biological assessment to identify endangered or threatened species and determine the likely effect of the federal action on those species and their critical habitat. 16 U.S.C. § 1536(c). At the end of the consultation process, the USFWS prepares a biological opinion stating whether the proposed action will jeopardize the species or destroy or adversely modify its critical habitat. 16 U.S.C. § 1536(c)(4). USFWS may also recommend reasonable alternatives that do not jeopardize the species. *Id.*

The animal species in the Lower Pecos Valley Water Planning Region that are subject to protection under the ESA are the following:

- Yellow-billed cuckoo (*Coccyzus americanus*) (threatened), found in Chaves, Eddy, Lincoln, and Otero counties.
- Piping plover (*Charadrius melodus*) (threatened), found in Chaves and Eddy counties; USFWS is implementing a final recovery plan.
- Least tern (*Sternula antillarum*) (endangered), found in Chaves, De Baca, Eddy, and Otero counties; USFWS is implementing a final recovery plan.
- Pecos gambusia (*Gambusia nobilis*) (endangered), found in Chaves and Eddy counties; USFWS is implementing a final recovery plan.
- Pecos bluntnose shiner (*Notropis simus pecosensis*) (threatened), found in Chaves, De Baca, and Eddy counties; USFWS is implementing a final recovery plan.
- Mexican spotted owl (*Strix occidentalis*) (threatened), found in Eddy, Lincoln, and Otero counties; USFWS is implementing a final recovery plan.
- Southwestern willow flycatcher (*Empidonax traillii extimus*) (endangered), found in Eddy and Lincoln counties; USFWS is implementing a final recovery plan.
- The amphipods Koster's springsnail (*Juturnia kosteri*), Noel's amphipod (*Gammarus desperatus*), Roswell springsnail (*Pyrgulopsis roswellensis*), and Pecos assiminea snail (*Assiminea pecos*) (all endangered), found in Chaves County at Bitter Lake National Wildlife Refuge; USFWS is implementing a final recovery plan

Of the threatened and endangered species found in the Lower Pecos Valley region, the protection and recovery of the southwestern willow flycatcher, yellow-billed cuckoo, least tern, and Pecos bluntnose shiner are most likely to affect water planning within the region. Any actions that are likely to harm the habitat used by these species will be subject to strict review and possible limitation.

There is also a threatened riparian plant species with critical habitat in the planning region, the Pecos sunflower (*Helianthus paradoxus*). The USFWS is implementing a final recovery plan for the species. Again, management of the critical habitat area for the sunflower may impact water use in the planning region.

4.2.1.2 New Mexico Wildlife Conservation Act

The New Mexico Wildlife Conservation Act, enacted in 1974, provides for the listing and protection of threatened and endangered wildlife species in the state. NMSA 1978, §§ 17-2-37 to 17-2-46. In enacting the law, the Legislature found that indigenous New Mexico species that are threatened or endangered "should be managed to maintain and, to the extent possible, enhance their numbers within the carrying capacity of the habitat." NMSA 1978, § 17-2-39(A).

The Act authorizes the New Mexico Department of Game and Fish to conduct investigations of indigenous New Mexico wildlife species suspected of being threatened or endangered to determine if they should be listed. NMSA 1978, § 17-2-40(A). Based on the investigation, the director then makes listing recommendations to the Game and Fish Commission. *Id.* The Act authorizes the Commission to issue regulations listing wildlife species as threatened or endangered based on the investigation and recommendations of the Department. NMSA 1978, § 17-2-41(A). Once a species is listed, the Department of Game and Fish, "to the extent practicable," is to develop a recovery plan for that species. NMSA 1978, § 17-2-40.1. The Act makes it illegal to "take, possess, transport, export, process, sell or offer for sale[,] or ship" any listed endangered wildlife species. NMSA 1978, § 17-2-41(C).

Pursuant to the Act, the Commission has listed over 100 wildlife species—mammals, birds, fish, reptiles, amphibians, crustaceans, and mollusks—as endangered or threatened. 19.33.6.8 NMAC. As of August 2014, 62 species were listed as threatened, and 56 species were listed as endangered. *Id.* In the Lower Pecos Valley Water Planning Region, all of the federally listed species discussed above are protected also under the New Mexico Act, along with several others.

4.2.2 Water Quality Laws

4.2.2.1 Federal Clean Water Act

The most significant federal law addressing water quality is the Clean Water Act (CWA), 33 U.S.C. §§ 1251 to 1387, which Congress enacted in its modern form in 1972, overriding President Nixon's veto. The stated objective of the CWA is to "restore and maintain the chemical, physical and biological integrity" of the waters of the United States. 33 U.S.C. § 1251(a).

4.2.2.1.1 *NPDES Permit Program (Section 402)*

The CWA makes it unlawful for any person to discharge any pollutant into waters of the United States without a permit. 33 U.S.C. § 1311(a). Generally, a "water of the United States" is a navigable water, a tributary to a navigable water, or an adjacent wetland, although the scope of the term has been the subject of considerable controversy as described below.

The heart of the CWA regulatory regime is the National Pollutant Discharge Elimination System (NPDES) permitting program under Section 402 of the Act. Any person—including a corporation, partnership, state, municipality, or other entity—that discharges a pollutant into waters of the United States from a point source must obtain an NPDES permit from the U.S. Environmental Protection Agency (EPA) or a delegated state. 33 U.S.C. § 1342. A point source is defined as "any discernible, confined, and discrete conveyance," such as a pipe, ditch, or conduit. 33 U.S.C. § 1362(14). NPDES permits include conditions setting effluent limitations based on available technology and, if needed, effluent limitations based on water quality.

The CWA provides that each NPDES permit issued for a point source must impose effluent limitations based on application of the best practicable, and in some cases the best available, pollution control technology. 33 U.S.C. § 1311(b). The Act also requires more stringent effluent limitations for newly constructed point sources, called new source performance standards. 33 U.S.C. § 1316(b). EPA has promulgated technology-based effluent limitations for dozens of categories of new and existing industrial point source dischargers. 40 C.F.R. pts. 405-471. These regulations set limits on the amount of specific pollutants that a permittee may discharge from a point source.

The CWA requires the states to develop water quality standards for individual segments of surface waters. 33 U.S.C. § 1313. Water quality standards have three components. First, states must specify designated uses for each body of water, such as public recreation, wildlife habitat, water supply, fish propagation, or agriculture. 40 C.F.R. § 131.10. Second, they must establish water quality criteria for each body of water, which set a limit on the level of various pollutants that may be present without impairing the designated use of the water body. *Id.* § 131.11. And third, states must adopt an antidegradation policy designed to prevent the water body from becoming impaired such that it cannot sustain its designated use. *Id.* § 131.12.

Surface water segments that do not meet the water quality criteria for the designated uses must be listed as "impaired waters." 33 U.S.C. § 1313(d)(l)(C). For each impaired water segment, states must establish "total maximum daily loads" (TMDLs) for those pollutants causing the water to be impaired, allowing a margin of safety. 33 U.S.C. § 1313(d)(1). The states must submit to EPA for approval the list of impaired waters and associated TMDLs. 33 U.S.C. § 1313(d)(2). The TMDL process, in effect, establishes a basin-wide budget for pollutant influx to a surface water. The states must then develop a continuing planning process to attain the standards, including effluent limitations for individual point sources. 33 U.S.C. § 1313(e).

New Mexico has taken steps to implement these CWA requirements. As discussed in Section 4.2.2.3, the New Mexico Water Quality Control Commission has adopted water quality standards for surface waters. The standards include designated uses for specific bodies of water, water quality criteria, and an antidegradation policy. 20.6.4 NMAC. The New Mexico Environment Department (NMED) has prepared a report listing impaired surface waters throughout the state. *State of New Mexico Clean Water Act Section 303(d)/Section 305(b) Integrated Report – 2014-2016* (Nov. 18, 2014). In the Lower Pecos Valley planning region, numerous segments of the Pecos River and Rio Hondo are on the impaired list.

EPA can delegate the administration of the NPDES program to individual states. 33 U.S.C. § 1251(b). New Mexico is one of only a handful of states that has neither sought nor received delegation to administer the NPDES permit program. Accordingly, EPA administers the NPDES program in New Mexico.

4.2.2.1.2 Dredge and Fill Permit Program (Section 404)

The CWA establishes a second important permitting program under Section 404, regulating discharges of "dredged or fill material" into waters of the United States. 33 U.S.C. § 1344. Although the permit requirement applies to discharges of such material into all waters of the United States, most permits are issued for the filling of wetlands. The program is administered primarily by the U.S. Army Corps of Engineers (Corps), although EPA has the authority to veto permits, and it shares enforcement authority with the Corps.

Like the section 402 NPDES permit program, the CWA allows the section 404 permit program to be delegated to states. 33 U.S.C. § 1344(g). Again, New Mexico has not received such delegation, and the program is implemented in New Mexico by the Corps and EPA.

4.2.2.1.3 Waters of the United States

The term "waters of the United States" delineates the scope of CWA jurisdiction, both for the Section 402 NPDES permit program, and for the Section 404 dredge and fill permit program. The term is not defined in the CWA, but is derived from the definition of "navigable waters," which means "waters of the United States including the territorial seas." 33 U.S.C. § 1362(7). In 1979, EPA promulgated regulations defining the term "waters of the United States." *See* 40 C.F.R. § 230.3(s) (2014) (between 1979 and 2014, the term remained substantially the same). This definition, interpreted and implemented by both EPA and the Corps, remained settled for many years.

In 2001, however, the Supreme Court began to cast doubt on the validity of the definition as interpreted by EPA and the Corps. The Court took up a case in which the Corps had asserted CWA jurisdiction over an isolated wetland used by migratory birds, applying the Migratory Bird Rule. The Court ruled that the Corps had no jurisdiction under the CWA, emphasizing that the CWA refers to "navigable waters," and that the isolated wetland had no nexus to any navigable-in-fact water. *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers,* 531 U.S.159 (2001).

The Court muddied the waters further in its 2006 decision in *Rapanos v. United States,* 547 U.S. 715 (2006) (consolidated with *Carabell v. U.S. Army Corps of Engineers*). Both of these cases challenged the Corps' assertion of CWA jurisdiction over wetlands separated from traditional navigable waters by a man-made ditch. In a fractured 4-1-4 decision, the Court ruled that the Corps did not have CWA authority to regulate these wetlands. The plurality opinion, authored by Justice Scalia, held that CWA jurisdiction extends only to relatively permanent standing or flowing bodies of water that constitute rivers, streams, oceans, and lakes. *Id.* at 739. Nevertheless, jurisdiction extends to streams or lakes that occasionally dry up, and to streams that flow only seasonally. *Id.* at 732, n.3. And jurisdiction extends to wetlands with a continuous surface connection to such water bodies. *Id.* at 742. The concurring opinion, written by Justice Kennedy, stated that CWA jurisdiction extends to waters having a "significant nexus" to a navigable water, but the Corps had failed to show such nexus in either case. *Id.* at 779-80. In dissent, Justice Stevens would have found CWA jurisdiction in both cases. *Id.* at 787.

There has been considerable confusion over the proper application of these opinions. Based on this confusion, EPA and the Corps recently amended the regulatory definition of "waters of the United States" to conform to the *Northern Cook County* and *Rapanos* decisions. Final Rule, 80 Fed. Reg. 37054 (June 29, 2015) codified at 33 C.F.R. pt 328; 40 C.F.R. pts 110, 112, 116, 117, 122, 230, 232, 300, 302, and 401. The new definition covers (1) waters used for interstate or foreign commerce, (2) interstate waters, (3) the territorial seas, (4) impounded waters otherwise meeting the definition, (5) tributaries of the foregoing waters, (6) waters, including wetlands, adjacent to the foregoing waters, (7) certain specified wetlands having a significant nexus to the foregoing waters, and (8) waters in the 100-year floodplain of the foregoing waters. 40 C.F.R. § 302.3.

Several states and industry groups have challenged the new definition in federal district courts and courts of appeal. In one such challenge, the district court granted a preliminary injunction temporarily staying the rule. *North Dakota v. EPA*, 127 F. Supp. 3d 1047 (D.N.D. 2015). Because the NMED and the NMOSE are plaintiffs in this case, the stay is effective—and the new definition does not now apply—in New Mexico. The United States has filed a motion asking the district court to dissolve the injunction and dismiss the case. This case is likely to be appealed.

4.2.2.2 Federal Safe Drinking Water Act

Enacted in 1974, the Safe Drinking Water Act (SDWA) regulates the provision of drinking water in the United States. 42 U.S.C. §§ 300f to 300j-26. The act's overriding purpose is "to insure the quality of publicly supplied water." *Arco Oil & Gas Co. v. EPA*, 14 F.3d 1431, 1436 (10th Cir. 1993). The SDWA requires EPA to promulgate national primary drinking water standards for protection of public health and national secondary drinking water standards for protection of public welfare. 42 U.S.C. § 300g-1. To provide this protection, the SDWA requires EPA, as part of the national primary drinking water regulations, to establish maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs) for drinking water contaminants. 42 U.S.C. § 300g-1(b)(1). The regulations apply to all "public water systems." 42 U.S.C. § 300g.

EPA has promulgated primary and secondary drinking water regulations. 40 C.F.R. pts. 141, 143. Most significantly, the agency has set MCLGs and MCLs for a number of drinking water contaminants, including 16 inorganic chemicals, 53 organic chemicals, turbidity, 6 microorganisms, 7 disinfectants and disinfection byproducts, and 4 radionuclides. 40 C.F.R. §§ 141.11, 141.13, 141.61-66. As noted above, New Mexico has incorporated these primary and secondary regulations into the state regulations. 20.7.10.100 NMAC, 20.7.10.101 NMAC.

4.2.2.3 Federal Comprehensive Environmental Response, Compensation, and Liability Act

Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or the "Superfund" law, in 1980 to address the burgeoning problem of uncontrolled hazardous waste sites. 42 U.S.C. §§ 9601 to 9675. CERCLA authorizes EPA to prioritize hazardous waste sites according to the degree of threat they pose to human health and the environment, including surface water and groundwater. EPA places the most serious sites on the National Priorities List (NPL). 42 U.S.C. § 9605. Sites on the NPL are eligible for federal funds for long-term remediation, which most often includes groundwater remediation.

4.2.2.4 New Mexico Water Quality Act

The most important New Mexico law addressing water quality is the New Mexico Water Quality Act (WQA), NMSA 1978, §§ 74-6-1 to 74-6-17. The New Mexico Legislature enacted the WQA in 1967. The purpose of the WQA is "to abate and prevent water pollution." *Bokum Res. Corp. v. N.M. Water Quality Control Comm'n*, 93 N.M. 546, 555, 603 P.2d 285, 294 (1979).

The WQA created the Water Quality Control Commission to implement many of its provisions. NMSA 1978, § 74-6-3. The WQA authorizes the Commission to adopt state water quality standards for surface and groundwaters and to adopt regulations to prevent or abate water pollution. NMSA 1978, § 74-6-4(C) and (D). The WQA also authorizes the Commission to adopt regulations requiring persons to obtain from the NMED a permit for the discharge into groundwater of any water contaminant. NMSA 1978, § 74-6-5(A). The Department must deny a discharge permit if the discharge would cause or contribute to contaminant levels in excess of water quality standards "at any place of withdrawal of water for present or reasonably foreseeable future use." NMSA 1978, § 74-6-5(E)(3). The WQA also authorizes the Commission to adopt regulations relating to monitoring and sampling, record keeping, and Department notification regarding the permit. NMSA 1978, § 74-6-5(I). Permit terms are generally limited to five years. NMSA 1978, § 74-6-5(H).

Accordingly, the Commission has adopted groundwater quality standards, regulations requiring discharge permits, and regulations requiring abatement of groundwater contamination. 20.6.2 NMAC. The water quality standards for groundwater are published at Sections 20.6.2.3100 through 3114 NMAC, and the regulations for discharge permits are published at Sections 20.6.2.3101 to 3114 NMAC.

An important part of these regulations are those addressing abatement. 20.6.2.4101 - .4115 NMAC. The purpose of the abatement regulations is to "[a]bate pollution of subsurface water so that all groundwater of the State of New Mexico which has a background concentration of 10,000 milligrams per liter or less total dissolved solids is either remediated or protected for use as domestic or agricultural water supply." 20.6.2.4101.A(1) NMAC. The regulations require that groundwater pollution must be abated to conform to the water quality standards. 20.6.2.4103.B NMAC. Abatement must be conducted pursuant to an abatement plan approved by the Department, 20.6.2.4104.A NMAC, or pursuant to a discharge permit, 20.6.2.3109.E NMAC.

In addition, the Commission has adopted standards for surface water. 20.6.1 NMAC. The objective of these standards, consistent with the federal Clean Water Act (Section 4.2.2.1) is "to establish water quality standards that consist of the designated use or uses of surface waters of the [S]tate, the water quality criteria necessary to protect the use or uses[,] and an antidegradation policy." 20.6.4.6.A NMAC. The standards include designated uses for specific bodies of water within the state, 20.6.4.50 to 20.6.4.806 NMAC; general water quality criteria, 20.6.4.13 NMAC; water quality criteria for specific designated uses, 20.6.4.900 NMAC; and water quality criteria for specific bodies of water, 20.6.4.50 to 20.6.4.806 NMAC. The standards also include an antidegradation policy, applicable to all surface waters of the state, to protect and maintain water quality. 20.6.4.8 NMAC. The antidegradation policy sets three levels of protection, closely matched to the federal regulations.

Lastly, the Commission has also adopted regulations limiting the discharge of pollutants into surface waters. 20.6.2.2100 to 2202 NMAC.

4.2.2.5 New Mexico Drinking Water Standards

The New Mexico Environmental Improvement Act created an Environmental Improvement Board, and it authorizes the Board to promulgate rules and standards for water supply. NMSA 1978, § 74-1-8(A)(2). The Board has accordingly adopted state drinking water standards for all public water systems. 20.7.10 NMAC. The state regulations incorporate by reference the federal primary and secondary drinking water standards, 40 C.F.R. parts 141 and 143, established by the EPA under the Safe Drinking Water Act (Section 4.2.2.2). 20.7.10.100 NMAC, 20.7.10.101 NMAC.

4.2.2.6 Tribal Law

The Mescalero Apache Tribe has not adopted surface water quality standards.

4.3 Legal Issues Unique to the Region and Local Conflicts Needing Resolution

Water shortages during drought remain an issue in the region. Conflicts have arisen over the NMISC's augmentation of the surface flows of the Pecos River in times of shortage by pumping groundwater. *See* NMSA 1978, § 72-1-2.4 (2002). Many people in the region do not like or support this practice. Also, PVACD and CID continue to have disputes over water allocation during times of shortage, as evidence by CID's priority call against PVACD in the spring of 2013. When water is scarce these issues will require attention from water users and planners in the region.

5. Water Supply

This section provides an overview of the water supply in the Lower Pecos Valley Water Planning Region, including climate conditions (Section 5.1), surface water and groundwater resources (Sections 5.2 and 5.3), water quality (Section 5.4), and the administrative water supply used for planning purposes in this regional water plan update (Section 5.5). Additional quantitative assessment of water supplies is included in Section 7, Identified Gaps between Supply and Demand.

The Handbook specifies that each of the 16 regional water plans briefly summarize water supply information from the previously accepted plan and provide key new or revised information that has become available since submittal of the accepted regional water plan. The information in this section regarding surface and groundwater supply and water quality is thus drawn largely from the accepted *Lower Pecos Valley Regional Water Plan* (PVWUO, 2001) and where appropriate, updated with more recent information and data from a number of sources, as referenced throughout this section.

Currently some of the key water supply updates and issues impacting the Lower Pecos Valley region are:

- The majority of the water use in the Pecos River Basin occurs in the lower basin—that is, from Sumner Dam to the lower end of the Carlsbad Irrigation District (CID) near the confluence of the Black and Pecos rivers. The principal constraint to use of this water is the 1948 Pecos River Compact. Over the past decade, New Mexico has made significant progress toward assuring long-term compliance with its obligations under the Compact. The New Mexico State Legislature, the NMOSE, the NMISC, and Pecos Basin water user groups continue to collaborate to address ongoing Compact and other Pecos Basin water management issues. Compact-related accomplishments include:
    - Since the U.S. Supreme Court issued its amended decree in 1988, New Mexico's efforts, including a total taxpayer investment of more than $130 million, have resulted in continued Compact compliance.

- The Pecos Settlement Agreement was signed in 2003 and implemented in June 2009 after New Mexico had acquired water rights associated with about 4,500 acres of land in the CID and about 7,500 acres in the Roswell Artesian UWB. Using these and other water rights, the state has constructed two well fields and pipelines designed to augment Pecos River flows according to the terms laid out in the Settlement.
- New Mexico has accumulated a Compact delivery credit of just over 100,000 acre-feet, providing some protection against a Compact delivery deficit.
- As a condition of the Pecos Settlement, the adjudication of CID water rights is nearly complete.

- Drought has significantly affected the region, with 2011, 2012, and 2013 being extraordinarily dry (until September 2013), resulting in record low flows in the Pecos River. As a consequence, even with continuous augmentation pumping by the NMISC in much of 2011, 2012, and 2013, it was not possible to meet the minimum Carlsbad Project supply target above which CID cannot call for priority administration pursuant to the 2003 Pecos Settlement Agreement. CID demanded a priority call until September 2013, when storm flows relieved the water shortage.

- Continued compliance with the USFWS's 2006 Biological Opinion (BO) for the threatened Pecos bluntnose shiner is an ongoing challenge. New Mexico, the USBR, and Pecos Basin water user groups have collaborated to comply with the BO; however, acquisition of additional water rights is needed to ensure long-term ESA compliance.

- Communities such as Ruidoso and Otis have historically experienced serious water supply problems during drought years. Continued drought planning is needed to design measures to ensure that essential water needs can be met.

- The net water supply impacts of physical watershed management techniques are not well documented or understood. In particular, quantification of the effectiveness of riparian vegetation removal, upland conifer thinning, and other water salvage methods needs further study to support well informed decisions.

- Water managers need to ensure continued compliance with the terms of the 2003 Pecos Settlement and the 1988 U.S. Supreme Court amended decree.

- Oil and gas development in the Capitan and Carlsbad basins raises concerns over potential impacts to the Pecos River and stress on the aquifers. Domestic, stock, and commercial wells permitted under 72-12-1.3 (underground public waters temporary use), along with new appropriations permitted under 72-12-3, are used to supply the oil and gas industry. With respect to wells permitted under 72-12-1.3, the NMOSE allows well owners to pump up to 9 acre-feet a year per well under three separate temporary commercial permits that are approved without advertising the change of use in the legal section of the newspaper. Well owners must reapply each year for these temporary permits.

5.1 Summary of Climate Conditions

The accepted regional water plan (PVWUO, 2001) included an analysis of historical temperature and precipitation in the region. This section provides an updated summary of temperature, precipitation, snowpack conditions, and drought indices pertinent to the region (Section 5.1.1). Studies relevant to climate change and its potential impacts to water resources in New Mexico and the Lower Pecos Valley region are discussed in Section 5.1.2.

5.1.1 Temperature, Precipitation, and Drought Indices

Table 5-1 lists the periods of record for weather stations in the Lower Pecos Valley region and identifies four stations that were used for analysis of weather trends. These stations were selected based on location, how well they represented conditions in their respective counties, and completeness of their historical records. In addition to the climate stations, data were available from one snowpack telemetry (SNOTEL) station and were used to document snowfall on Sierra Blanca (Table 5-1). The locations of the climate stations for which additional data were analyzed are shown in Figure 5-1.

Long-term minimum, maximum, and average temperatures for the four climate stations are detailed in Table 5-2, and average summer and winter temperatures for each year of record are shown on Figure 5-2.

The average precipitation distribution across the entire region is shown on Figure 5-3, and Table 5-2 lists the minimum, maximum, and long-term average annual precipitation (rainfall and snowmelt) at the four representative stations in the planning region. Total annual precipitation for the selected climate stations is shown in Figure 5-4.

The Natural Resources Conservation Service (NRCS) operates one SNOTEL station in the planning region, the Sierra Blanca station, located in the Sacramento Mountains near Ruidoso. This station provides snow depth and snow water equivalent data (Figure 5-5) (NRCS, 2014a).

The snow water equivalent is the amount of water, reported in inches, within the snowpack, or the amount of water that would result if the snowpack were instantly melted (NRCS, 2014b). The end of season snowpack is a good indicator of the runoff that will be available to meet water supply needs. A summary of the early April (generally measured within a week of April 1) snow depth and snow water equivalent information at the Sierra Blanca station is provided on Figure 5-5.

Table 5-1. Lower Pecos Valley Climate Stations
Page 1 of 3

Climate Stations [a]	Latitude	Longitude	Elevation	Precipitation		Temperature	
				Data Start	Data End	Data Start	Data End
De Baca County							
Alamogordo Dam	34.60	–104.38	4,314	1/1/1939	Present	1/1/1948	Present
Canton	34.28	–104.16	4,056	7/1/1918	8/31/2005	—	—
Dunlap 4 NE	34.13	–104.50	4,032	6/1/1948	9/30/1961	3/1/1953	9/30/1961
Fort Sumner	34.47	–104.23	4,025	5/1/1908	9/30/2011	5/1/1908	9/30/2011
Fort Sumner 5 S	34.39	–104.25	4,050	1/1/1948	Present	11/1/2004	Present
Sumner Lake	34.60	–104.38	4,306	1/1/1939	Present	1/1/1948	Present
Taiban	34.45	–104.02	4,134	4/1/1952	6/30/1977	—	—
Yeso	34.40	–104.62	4,852	1/1/1942	Present	4/1/1960	Present
Yeso Overton Ranch	34.32	–104.73	5,003	8/1/1943	7/31/1959	6/1/1949	7/31/1959
Lincoln County							
Arabella Near	33.63	–105.17	5,364	10/1/1901	2/28/1946	11/1/1901	8/31/1905
Baca Ranch Ranger Stn	33.53	–105.37	6,400	4/1/1916	12/31/1930	—	—
Capitan	33.53	–105.59	6,480	7/1/1909	Present	1/1/1920	Present
Circle F Ranch	33.90	–105.00	5,400	1/1/1942	1/31/1995	3/1/1962	1/31/1995
Corona	34.25	–105.58	6,654	7/1/1909	1/31/1977	1/1/1911	2/28/1977
Corona 10 SW	34.15	–105.70	6,680	10/1/1992	Present	10/1/1992	Present
Corona 11 SSW	34.10	–105.68	6,500	12/1/1977	9/30/1992	12/1/1977	9/30/1992
Farnsworth Ranch	33.90	–105.00	5,400	1/1/1942	1/31/1995	3/1/1962	1/31/1995
Fort Stanton	33.50	–105.52	6,224	12/1/1896	11/30/1974	11/1/1896	11/30/1974
Gallinas Ranger Stn	34.15	–105.65	6,644	7/1/1909	4/30/1946	—	—
Hondo 1 SE	33.38	–105.25	5,270	11/1/1908	9/30/1951	11/1/1908	5/31/1918
Picacho 2 WSW	33.34	–105.17	5,042	3/1/1980	Present	3/1/1980	Present

Source: WRCC, 2014 — = Information not available

[a] Stations in **bold** type were selected for detailed analysis.

Table 5-1. Lower Pecos Valley Climate Stations
Page 2 of 3

Climate Stations [a]	Latitude	Longitude	Elevation	Precipitation		Temperature	
				Data Start	Data End	Data Start	Data End
Lincoln County (cont.)							
Ramon 8 SW	34.15	–105.00	5,327	3/1/1957	7/31/2009	3/1/1957	5/31/2009
Ruidoso 2	33.35	–105.67	6,937	1/1/1942	Present	1/1/1942	Present
Ruidoso 2 NNE	33.38	–105.62	6,840	1/1/1942	Present	1/1/1942	Present
Tinnie	33.35	–105.13	5,043	6/1/1951	10/31/1979	8/1/1951	10/31/1979
Chaves County							
Bitter Lakes WL Refuge	33.46	–104.40	3,664	12/1/1950	Present	12/1/1950	Present
Elk 2 E	32.94	–105.33	5,845	6/1/1895	Present	6/1/1895	Present
Felix	33.00	–105.10	5,305	3/1/1917	9/30/1978	4/1/1917	3/31/1919
Flying H	33.00	–105.10	5,305	3/1/1917	9/30/1978	4/1/1917	3/31/1919
Hagerman	33.12	–104.33	3,422	4/1/1920	3/31/1960	8/1/1920	1/31/1960
Mesa Service Stn	33.98	–104.68	5,003	10/1/1938	2/28/1953	10/1/1938	2/28/1953
Roswell	33.32	–104.43	3,573	2/1/1893	2/28/1950	2/1/1893	2/28/1950
Roswell FAA Airport	33.31	–104.51	3,649	1/1/1949	Present	1/1/1949	Present
Roswell WSO Airport	33.30	–104.53	3,649	1/1/1893	Present	2/1/1893	8/31/2010
Otero County							
Mayhill Ranger Stn	32.92	–105.47	6,565	2/1/1917	8/31/1976	5/1/1939	8/31/1976
Whitetail	33.23	–105.55	7,454	10/1/1914	2/28/1959	—	—
Eddy County							
Artesia 6 S	32.75	–104.38	3,366	6/1/1905	Present	6/1/1905	Present
Brantley Dam	32.52	–104.38	3,213	8/1/1987	8/31/2012	8/1/1987	8/31/2012
Carlsbad	32.35	–104.22	3,120	2/1/1900	Present	2/1/1900	Present
Carlsbad Caverns	32.18	–104.44	4,435	2/1/1930	Present	2/1/1935	Present

Source: WRCC, 2014 — = Information not available

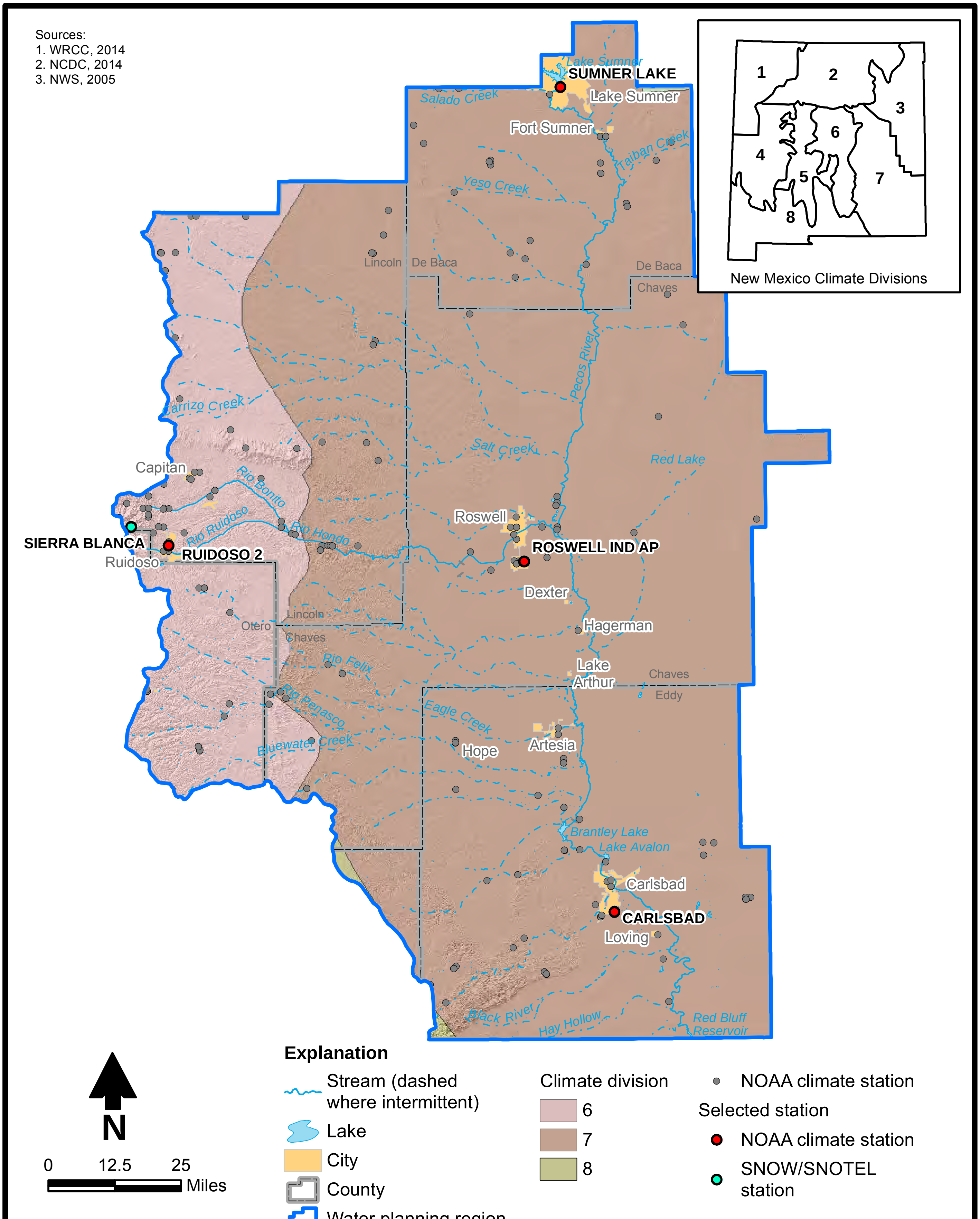
[a] Stations in **bold** type were selected for detailed analysis.

Table 5-1. Lower Pecos Valley Climate Stations
Page 3 of 3

Climate Stations [a]	Latitude	Longitude	Elevation	Precipitation		Temperature	
				Data Start	Data End	Data Start	Data End
Eddy County (cont.)							
Carlsbad FAA Airport	32.34	–104.26	3,232	1/1/1930	Present	2/1/1930	Present
Carson Seep Near	32.10	–104.77	6,204	7/1/1895	8/31/1941	8/31/1895	2/28/1922
Duval Potash Mine	32.53	–103.90	3,524	3/1/1968	5/31/1999	3/1/1968	5/31/1999
Hope	32.81	–104.73	4,091	8/1/1905	Present	1/1/1919	Present
Lake Avalon	32.48	–104.25	3,212	8/1/1914	2/28/1979	12/1/1951	2/28/1979
Lake Mc Millan	32.60	–104.33	3,281	1/1/1940	10/31/1949	1/1/1940	10/31/1949
Loving	32.28	–104.08	3,022	11/1/1917	9/30/1949	—	—
Potash Mine	32.50	–103.93	3,323	12/1/1954	1/31/1968	12/1/1954	1/31/1968
Queen Ranger Stn	32.20	–104.73	5,853	1/1/1963	3/31/1975	—	—
Waste Isoltn Pilot Plt	32.38	–103.80	3,411	9/1/1986	Present	9/1/1986	Present
Western Ag–Minerals	32.54	–103.94	3,520	3/1/1968	5/31/1999	3/1/1968	5/31/1999
Snotel Stations							
Sierra Blanca – SNTL	33.40	–105.79	10,280	10/3/2002	Present	NR	NR

Source: WRCC, 2014
[a] Stations in **bold** type were selected for detailed analysis.

— = Information not available
NR = Temperature is not recorded at SNOTEL stations.



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Climate Stations

Figure 5-1

Table 5-2. Temperature and Precipitation for Selected Climate Stations Lower Pecos Valley Water Planning Region

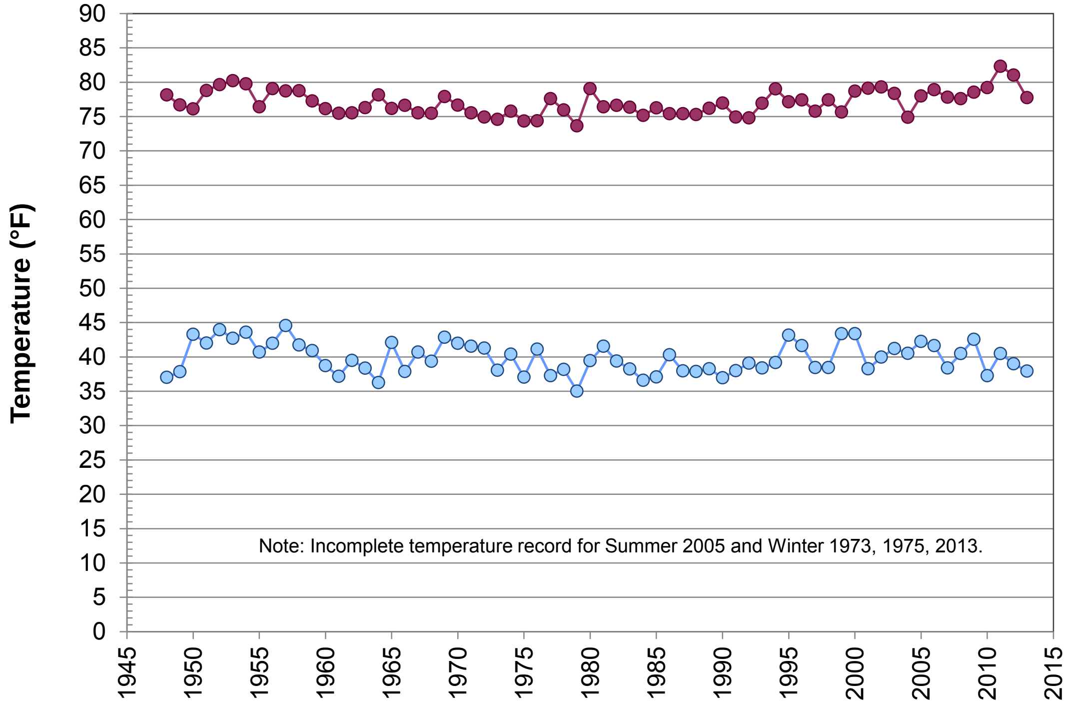
Station Name	Precipitation (inches)				Temperature			
	Average Annual [a]	Minimum [b]	Maximum [b]	% of Possible Observations [c]	Average (°F)			% of Possible Observations [c]
					Annual [d]	Minimum [e]	Maximum [e]	
Sumner Lake	14.02	6.13	22.60	32.1	58.2	43.0	73.4	34.4
Ruidoso 2	24.78	20.76	28.74	100	49.3	33.3	65.3	99.8
Roswell FAA Airport	12.55	2.90	24.80	35.5	61.2	46.6	75.9	34.4
Carlsbad	12.84	2.95	33.94	98.1	62.9	47.2	78.6	94.3

Source: Statistics computed by Western Regional Climate Center (2014)

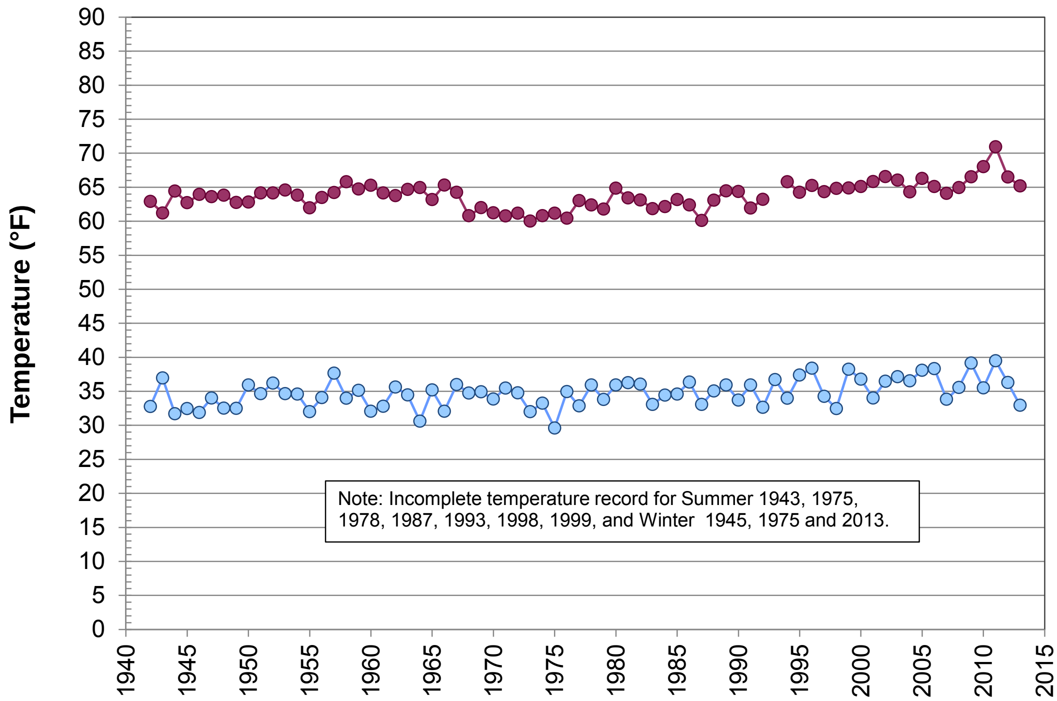
ft amsl = Feet above mean sea level
°F = Degrees Fahrenheit

[a] Average of annual precipitation totals for the period of record at each station.
[b] Minimum and maximum recorded annual precipitation amounts for each station.
[c] Amount of completeness in the daily data set that was recorded at each station (e.g., 99% complete means there is a 1% data gap).
[d] Average of the daily average temperatures calculated for each station.
[e] Average of the daily minimum (or maximum) temperature recorded daily for each station.

Sumner Lake



Ruidoso 2



Average summer temperature (June, July, August)
Average winter temperature (December, January, February)

LOWER PECOS VALLEY
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Average Temperature
Sumner Lake and Ruidoso 2 Climate Stations

Figure 5-2a

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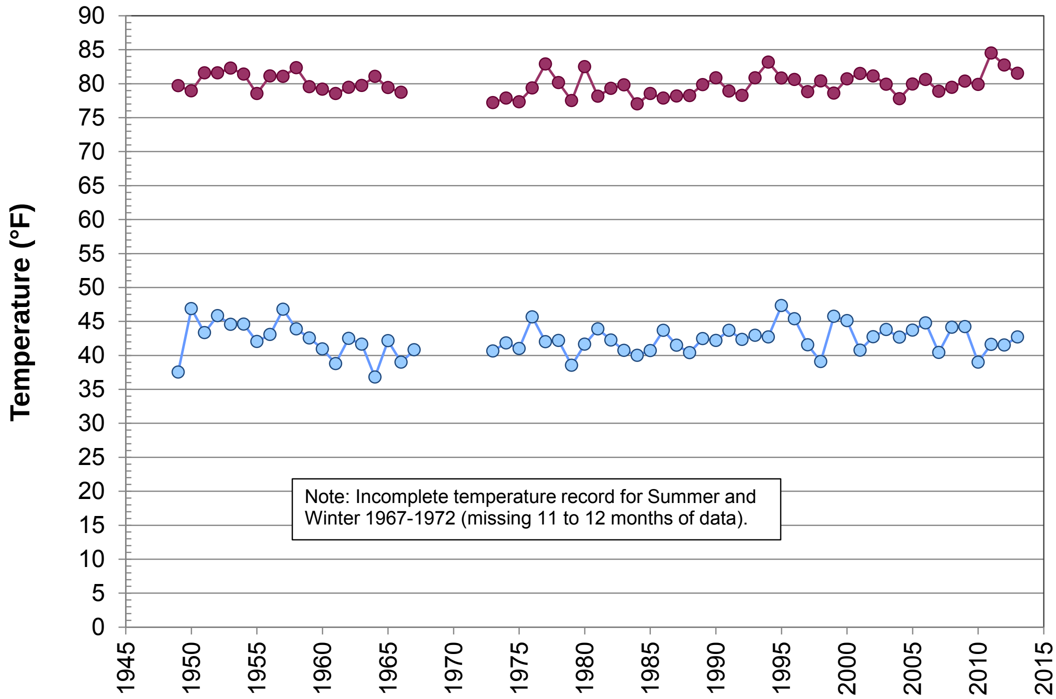
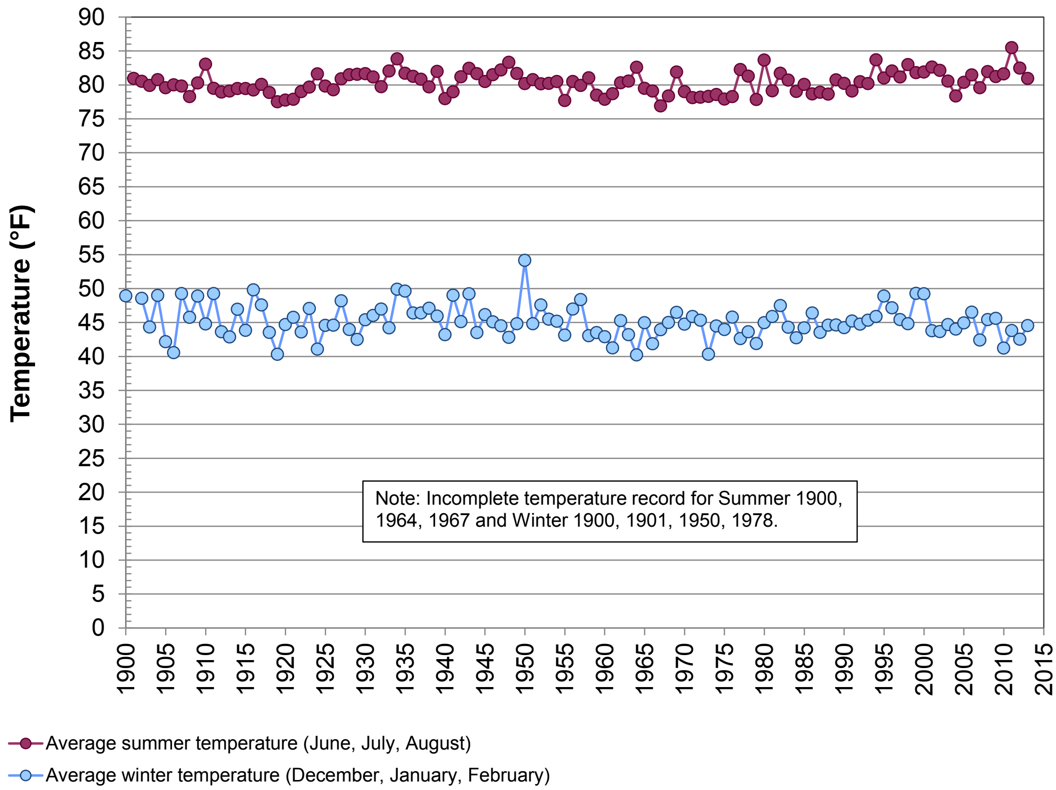
Roswell FAA Airport



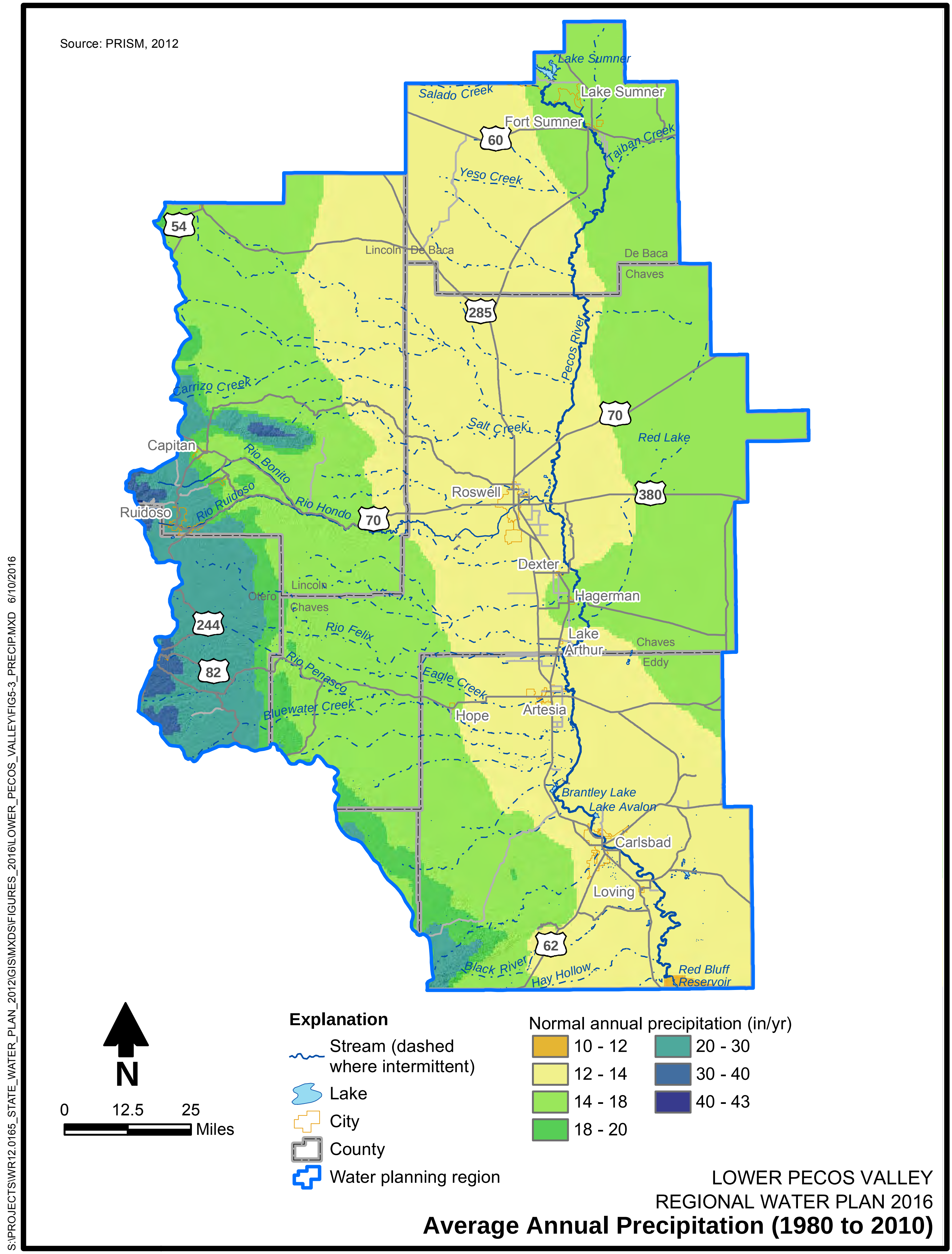
Carlsbad



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Average Temperature
Roswell FAA Airport and Carlsbad Climate Stations

Figure 5-2b



LOWER PECOS VALLEY
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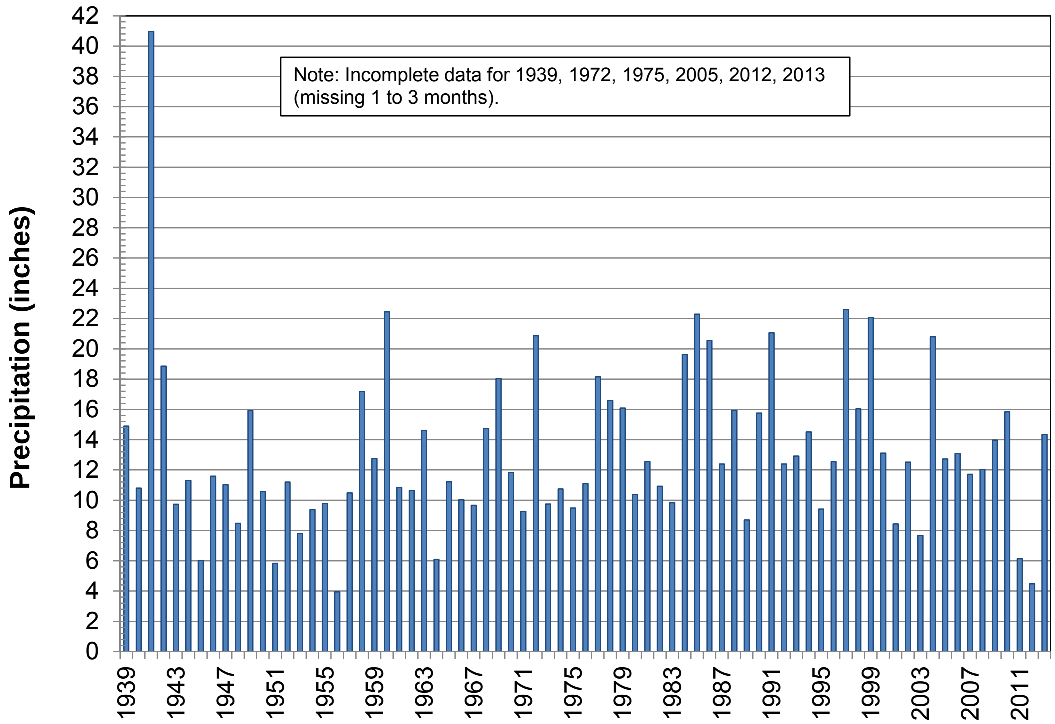
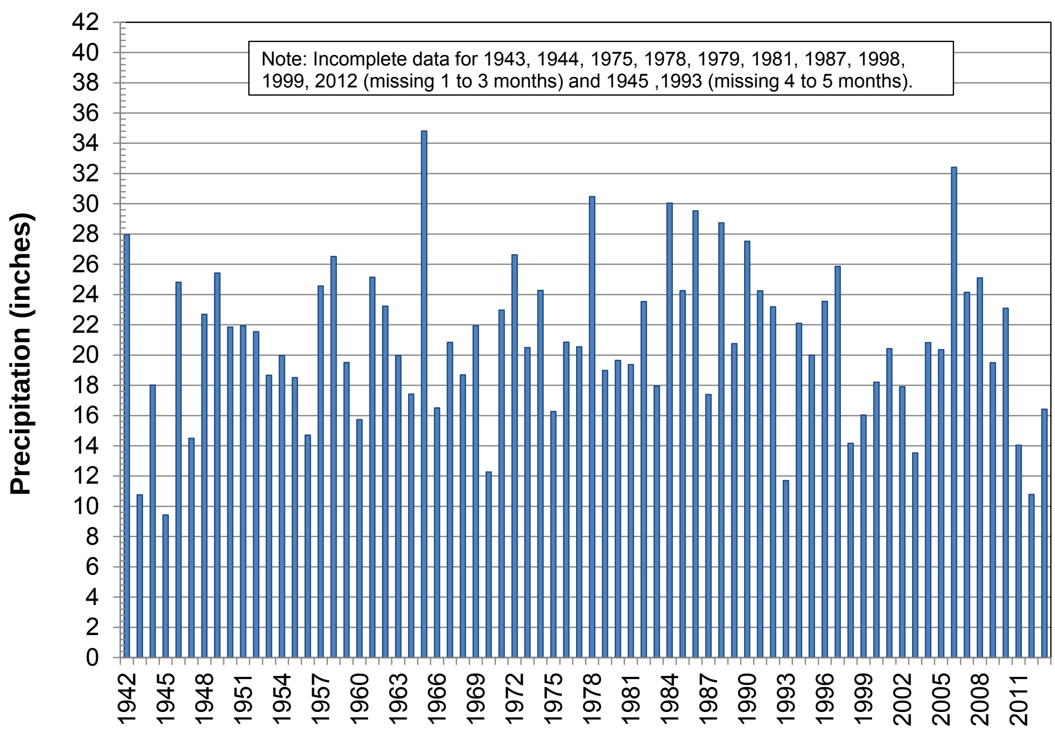
Average Annual Precipitation (1980 to 2010)

Figure 5-3

Sumner Lake



Ruidoso 2

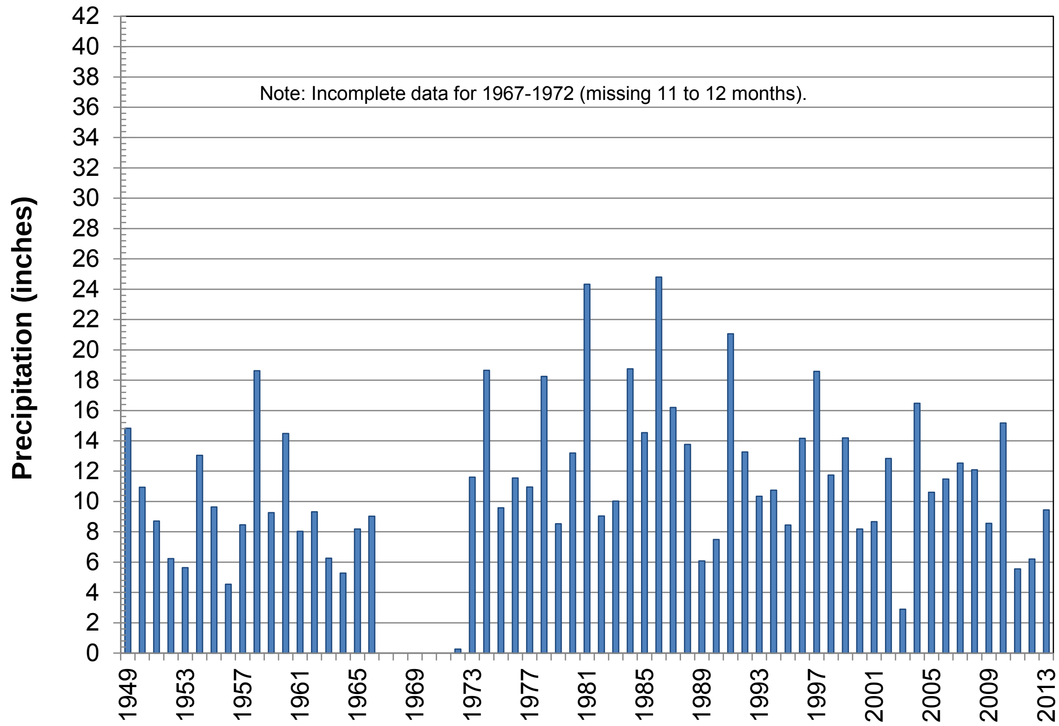


LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

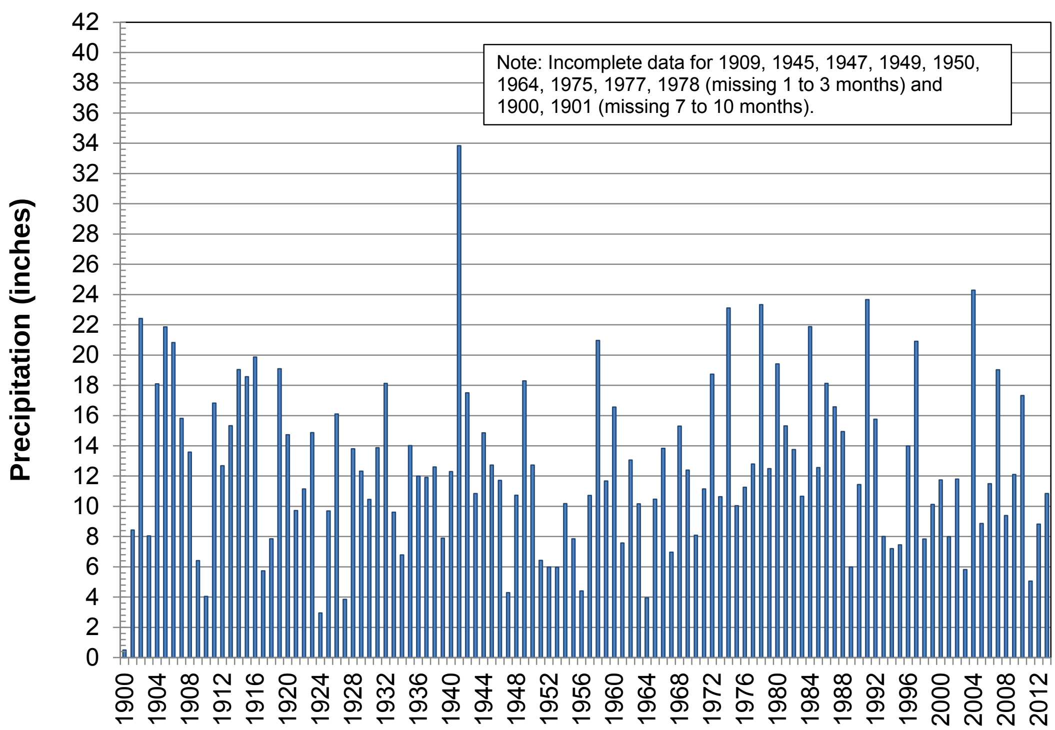
Annual Precipitation
Sumner Lake and Ruidoso 2 Climate Stations

Figure 5-4a

Roswell FAA Airport



Carlsbad



LOWER PECOS VALLEY
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Annual Precipitation, Roswell FAA Airport and Carlsbad Climate Stations

Figure 5-4b

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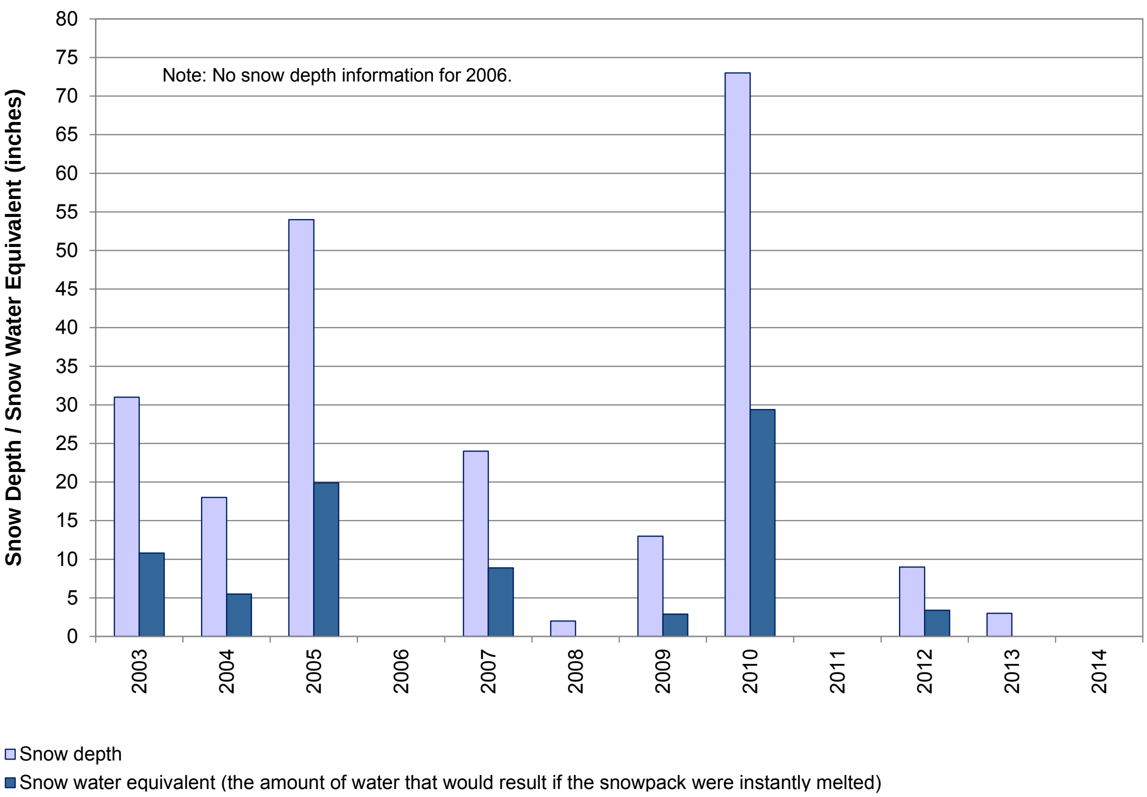
Sierra Blanca SNOTEL



Notes: 1. Measurements made in the last few days of March or first few days of April.
2. Years with no bars visible are years with zero snow depth (unless otherwise noted).

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LOWER PECOS VALLEY
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Snow Depth and Snow Water Equivalent for April

Figure 5-5

Another way to review long-term variations in climate conditions is through drought indices. A 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. The Palmer Drought Severity Index (PDSI) was created by W.C. Palmer (1965) to measure the 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, the index is widely used to assess the weather during any time period relative to historical conditions. The PDSI classifications for dry to wet periods are provided in Table 5-3.

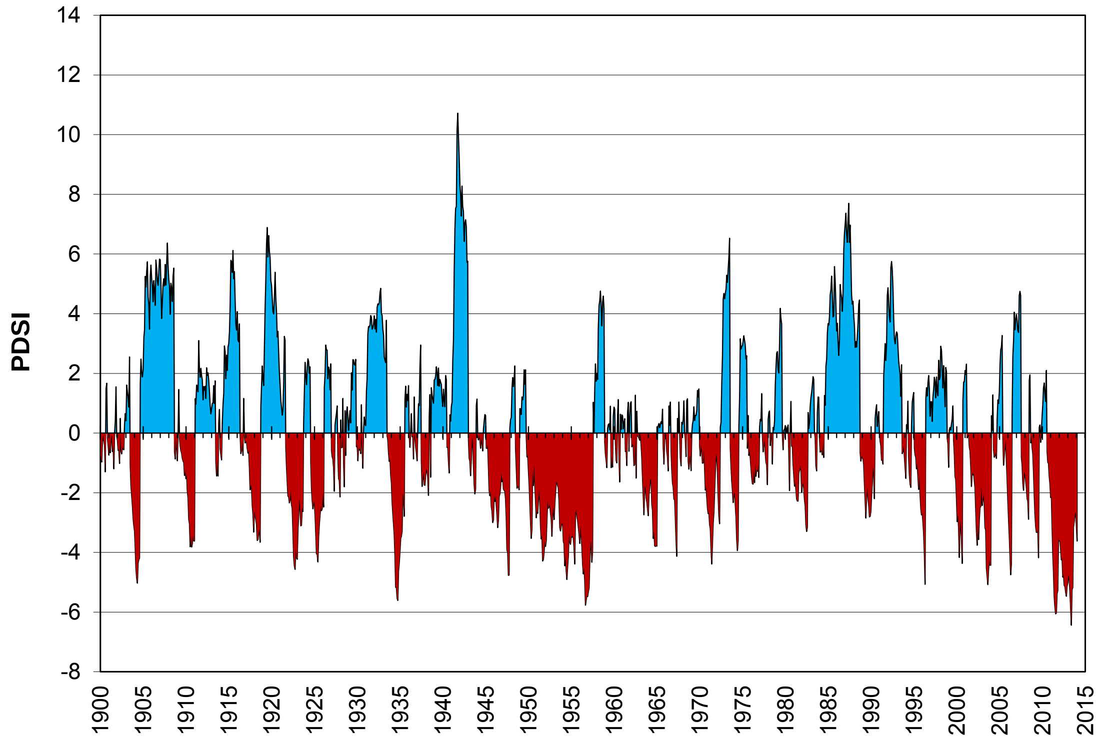
Table 5-3. Palmer Drought Severity Index Classifications

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

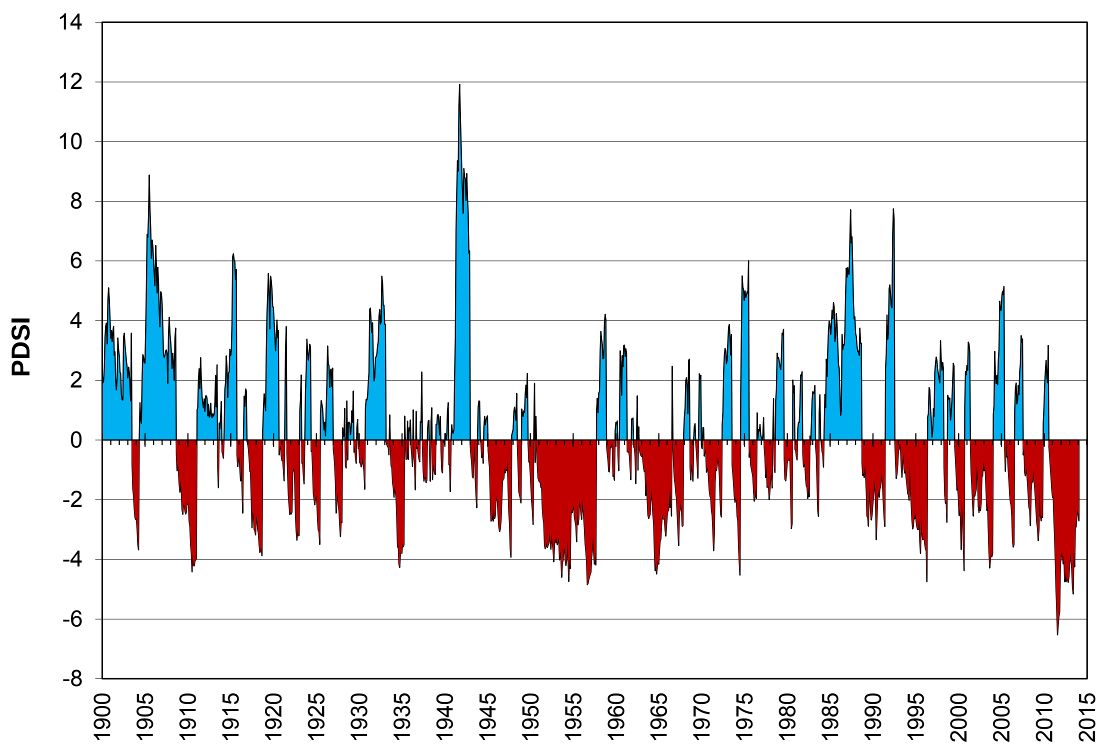
There are considerable limitations when using the PDSI, as it may not describe rainfall and runoff that varies from location to location within a climate division and may also lag in indicating emerging droughts by several months. Also, the PDSI does not consider groundwater or reservoir storage, which 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, and it provides a good indication of long-term relative variations in drought conditions, as PDSI records are available for more than 100 years.

The PDSI is calculated for climate divisions throughout the United States. The Lower Pecos Valley region falls primarily within New Mexico Climate Division 7 (the Southeastern Plains Climate Division), with the western side of the region in Division 6 (the Central Highlands Climate Division) and tiny portions of the southwestern part of the region in Division 8 (the Southern Desert Climate Division) (Figure 5-1). Figure 5-6 shows the long-term PDSI for Divisions 6 and 7. Of interest are the large variations from year to year in both divisions, which are similar in pattern though not necessarily in magnitude.

Climate Division 6



Climate Division 7



Note: Blue indicates wetter than average conditions and red indicates drier than average conditions, as described on Table 5-3.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Palmer Drought Severity Index
New Mexico Climate Divisions 6 and 7

Figure 5-6

The chronological history of drought, as illustrated by the PDSI, indicates that the most severe droughts in the last century occurred in the early 1900s, the 1950s, the early 2000s, and in recent years (2011 to 2013) (Figure 5-6).

The likelihood of drought conditions developing in New Mexico is influenced by several weather patterns:

- *El Niño/La Niña:* El Niño and La Niña are characterized by a periodic warming and cooling, respectively, of sea surface temperatures across the central and east-central equatorial Pacific. Years in which El Niño is present are more likely to be wetter than average in New Mexico, and years with La Niña conditions are more likely to be drier than average, particularly during the cool seasons of winter and spring.

- *The Pacific Decadal Oscillation (PDO):* The PDO is a multi-decadal pattern of climate variability caused by shifting sea surface temperatures between the eastern and western Pacific Ocean that cycle approximately every 20 to 30 years. Warm phases of the PDO (shown as positive numbers on the PDO index) correspond to El Niño-like temperature and precipitation anomalies (i.e., wetter than average), while cool phases of the PDO (shown as negative numbers on the PDO index) correspond to La Niña-like climate patterns (drier than average). It is believed that since 1999 the planning region has been in the cool phase of the PDO.

- *The Atlantic Multidecadal Oscillation (AMO):* The AMO refers to variations in surface temperatures of the Atlantic Ocean which, similarly to the PDO, cycle on a multi-decade frequency. The pairing of a cool phase of the PDO with the warm phase of the AMO is typical of drought in the southwestern United States (McCabe et al., 2004; Stewart, 2009). The AMO has been in a warm phase since 1995. It is possible that the AMO may be shifting to a cool phase but the data are not yet conclusive.

- *The North American Monsoon* is characterized by a shift in wind patterns in summer, which occurs as Mexico and the southwest U.S. warm under intense solar heating. As this happens, the flow reverses from dryland areas to moist ocean areas. Low-level moisture is transported into the region primarily from the Gulf of California and eastern Pacific. Upper-level moisture is transported into the region from the Gulf of Mexico by easterly winds aloft. Once the forests of the Sierra Madre Occidental green up from the initial monsoon rains, evaporation and plant transpiration can add additional moisture to the atmosphere that will then flow into the region. If the Southern Plains of the U.S. are unusually wet and green during the early summer months, that area can also serve as a moisture source. This combination causes a distinct rainy season over large portions of western North America (NWS, 2015).

5.1.2 Recent Climate Studies

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. In addition to natural climatic cycles (i.e., El Niño/La Niña, PDO, AMO [Section 5.1.1]) that affect precipitation patterns in the southwestern United States, there has been considerable recent research on potential climate change scenarios and their impact on the Southwest and New Mexico in particular.

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.

In the United States, regional assessments conducted by the U.S. 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, 2009). Most of the major river systems in the southwestern U.S. 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 NMOSE and NMISC (2006) conducted a study of observed climate conditions over the past century and found that observed wintertime average temperatures had increased statewide by about 1.5°F since the 1950s. Predictions of annual precipitation are subject to greater uncertainty "given poor representation of the North American monsoon processes in most climate models" (NMOSE/NMISC, 2006).

A number of other studies predict temperature increases in New Mexico from 5° to 10°F by the end of the century (Forest Guild, 2008; Hurd and Coonrod, 2008; USBR, 2011). Predictions of annual precipitation are subject to greater uncertainty, particularly regarding precipitation during the summer monsoon season in the southwestern U.S.

The NMISC is currently working with the Bureau of Reclamation on a basin study to assess the predicted impacts of climate change in the Pecos Valley. This report is expected to be completed in 2017.

Based on these studies, the effects of climate change that are likely to occur in New Mexico and the planning region include (NMOSE/NMISC, 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 areas, grasslands, and forests, and thus less recharge to aquifers.
- Reservoir and other open water evaporation are expected to increase. Soil evaporation will also increase.
- Precipitation is expected to be more concentrated and intense, leading to increased frequency and severity of flooding.
- Streamflows in major rivers across the Southwest are projected to decrease substantially during this century (e.g., Christensen et al., 2004; Hurd and Coonrod, 2008; USBR, 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 streamflow 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). Stress from either of these factors leave forests increasingly susceptible to insects, forest fires, and desiccation. Greater temperatures increase insect survivability and fire risk.

To minimize the impact of these changes, it is imperative that New Mexico plan for variable water supplies, including focusing on drought planning and being prepared to maximize storage from extreme precipitation events while minimizing their adverse impacts.

5.2 Surface Water Resources

Surface water supplies approximately 30 percent of the water currently diverted in the Lower Pecos Valley Water Planning Region, with its primary uses being for irrigated agriculture and reservoir evaporation. The dominant waterways flowing in the region are the Pecos River and its tributaries. Major surface drainages (including both perennial and intermittent streams) and watersheds in the planning region are shown on Figure 5-7.

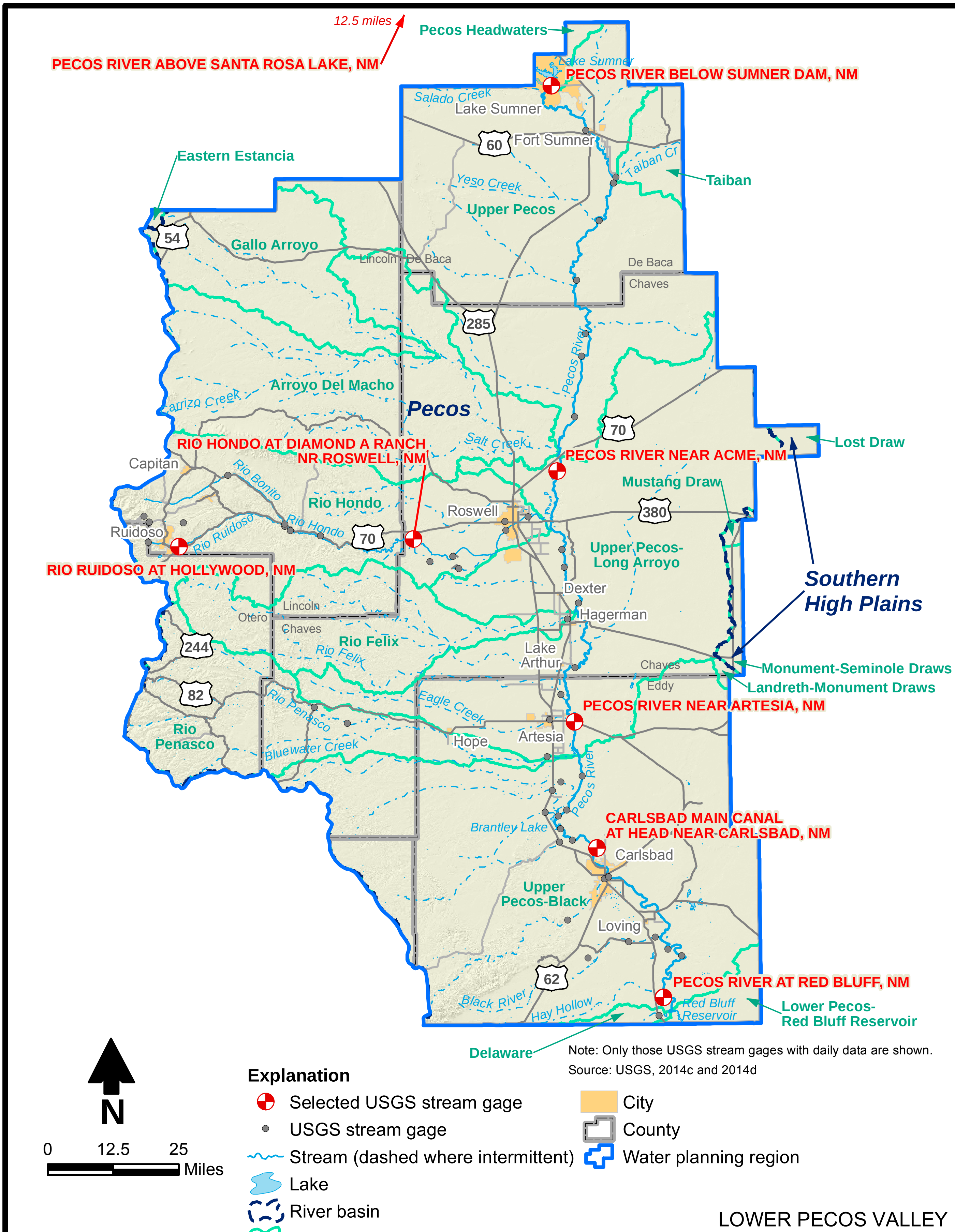
The Pecos River enters the Lower Pecos Basin below Sumner Dam and exits the region at the Texas state line. An important component of surface water flow in the Lower Pecos Basin is baseflow contribution to the Pecos River from groundwater between the Acme and Artesia gages in the Roswell Basin. The underlying aquifer system that provides the baseflow consists of the shallow alluvium in the Roswell Basin, an underlying sequence of leaky confining beds, and below that, the very highly transmissive carbonate rocks that comprise the Roswell artesian aquifer system. The exchange of water between aquifer and river is an integral part of the river's flow system and thus a necessary consideration in any study of surface water supplies in the basin.

The Pecos River streamflow is extremely variable from year to year and over longer periods of time. The annual inflow at Fort Sumner is less than 70,000 acre-feet to more than 600,000 acre-feet. Streamflows are composed of snowmelt from the headwaters in the Sangre de Cristo Mountains, baseflow gain largely originating from the Sacramento Mountains to the west of the river, and flood runoff.

When evaluating surface water information, it is important to note that streamflow does not represent available supply, as there are also water rights and interstate compact limitations. The administrative water supply discussed in Section 5.5 is intended to represent supply considering both physical and legal limitations, but excluding potential compact limitations. The information provided in this section is intended to illustrate the variability and magnitude of streamflow, and particularly the relative magnitude of streamflow in recent years.

Deliveries of water to Texas are governed by the Pecos River Compact and the 1988 Supreme Court amended decree. The specific methodology for determining New Mexico's annual Compact delivery requirement is contained in the Federal Pecos River Master's Manual. New Mexico's delivery to Texas is the combination of measurements at the Pecos River at Red Bluff, New Mexico gage, about 3.2 miles north of the state line, and at the Delaware River near Red Bluff gage (the Delaware River enters the Pecos River slightly downstream of the Pecos River at Red Bluff gage).

The flow of the Pecos River is largely controlled by the main stem dams (Santa Rosa, Sumner, Brantley, and Avalon) that collectively control delivery of water to the CID. Historically, the entire flow of the Pecos River at Lake Avalon was in many years diverted into the main CID canal for irrigation purposes. More recently, since the 1988 U.S. Supreme Court Amended Decree, there have been regular deliveries from Avalon Dam to the Texas border to help ensure New Mexico's compliance with its Compact delivery requirements. The deliveries have been facilitated through lease agreements between CID and NMISC and, more recently, under the provisions of the 2003 Pecos Settlement Agreement.



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Major Surface Drainages, Stream Gages, Reservoirs, and Lakes

Figure 5-7

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_2016\LOWER_PECOS_VALLEY\FIG5-7_SURFACE_WATER.MXD 6/10/2016

The surface water resources of the Hondo Basin include the Hondo and Ruidoso rivers, Eagle Creek, and Rio Bonito, all tributaries to the Pecos River that are used for irrigation, livestock, fisheries, and urban areas. The Village of Ruidoso relied heavily on the surface water supplies from Alto and Grindstone reservoirs on Eagle Creek and the Rio Ruidoso, respectively, until the Little Bear Fire and subsequent floods and debris flows damaged the watershed in 2012. Stringent water conservation measures were in place because of the Little Bear Fire's impact on the Village's ability to deliver water to its customers until the Village started diverting water again in 2014 (Hernandez, 2015). The Village of Ruidoso added a diversion pump in Carrizo Creek after the fire and pumped water several miles up to Grindstone Reservoir (Boyda, 2015). Surface water diversions continue to be impacted with mud flows and debris during intense rainfall events, requiring the surface water systems to be shut down.

The Village does not have sufficient water rights to meet the growing demand and has applied for temporary transfers of water rights (of about 409 acre-feet) and 22 acre-feet of permanent transfers from agricultural water rights downstream on the Rio Ruidoso. These applications have been protested because the "transfer from" locations are downstream of other water rights on the Rio Ruidoso and could result in impairment of other water rights.

The Village has four wells on U.S. Forest Service land that have been the subject of controversy and protest. A settlement order in 2006 resolved the allowable water rights, but the special use permit with the Forest Service may limit when pumping can occur (Hernandez, 2015). Baseflow analysis of the North Fork of Eagle Creek was investigated by the U.S. Geological Survey (USGS) (Matherne et al., 2011) to better understand the impacts of pumping from Village of Ruidoso wells in 1988 on the streamflow. Their study showed that the 1970–80 mean annual discharge, direct runoff, and baseflow were higher than for the period from 1989–2008, and the amount of direct runoff and base flow as a percentage of measured discharge was similar for the two periods. The decrease in streamflow is likely due to a combination of pumping and reduced recharge.

Tributary flow is not monitored in every subwatershed in the planning region. However, streamflow data are collected by the USGS and various cooperating agencies at stream gage sites in the planning region. Gaged tributaries in the Lower Pecos Basin include Cottonwood Creek, Eagle Draw, Rio Hondo, Rio Felix, Rio Peñasco, Rocky Arroyo, Fourmile Draw, North Seven Rivers, South Seven Rivers, Dark Canyon, the Black River, and the Delaware River. Many smaller, ungaged tributaries also contribute flow. Table 5-4a lists the locations and periods of record for data collected at some of the stream gages in the region, as well as the drainage area and estimated irrigated acreage for surface water diversions upstream of the station. Table 5-4b provides the minimum, median, and maximum annual yield for all gages that have 10 or more years of record. In addition to the large variability in annual yield, streamflow also varies from month to month within a year, and monthly variability or short-term storms can have flooding impacts, even when annual yields are low. Table 5-5 provides monthly summary statistics for each of the stations with 10 or more years of record.

Table 5-4a. USGS Stream Gage Stations
Page 1 of 4

USGS Station [a]							Period of Record	
Name [b]	Number	Latitude	Longitude	Elevation (ft amsl)	Drainage Area (sq mi)	Irrigated Upstream Land [c] (acres)	Start Date	End Date
Guadalupe County								
Pecos River above Santa Rosa Lake, NM [d]	08382650	35.0594444	–104.761111	4,760	2,340	11,800	2/28/1976	Present
De Baca County								
Pecos River Below Sumner Dam, NM	08384500	34.6040556	–104.387917	4,143	4,390	12,500	10/1/1912	Present
Pecos River Near Fort Sumner, NM	08385500	34.4786776	–104.272476		4,949	—	10/1/1994	9/30/2003
Pecos River Below Fort Sumner, NM	08385520	34.3481265	–104.173027	3,915	5,600	—	8/22/1957	9/15/1970
Pecos River Below Taiban Creek Near Fort Sumner,NM	08385522	34.3322222	–104.181111	3,910	5,908	19,100	8/12/1992	Present
Pecos River Bl. Yeso Arroyo Nr. Ft. Sumner, NM	08385620	34.2278523	–104.229694	3,845	7,000	—	11/11/1964	9/30/1968
Pecos River Near Dunlap, NM	08385630	34.0633333	–104.306667	3,760	6,647	19,100	8/20/1993	Present
Lincoln County								
Rio Ruidoso at Hollywood, NM	08387000	33.3266917	–105.625333	6,420	120	NA	10/1/1953	Present
North Fork Eagle Creek Near Alto, NM	08387550	33.4095472	–105.740764	7,900	3	NA	9/7/2007	Present
South Fork Eagle Creek Near Alto, NM	08387575	33.3924083	–105.724681	7,630	3	NA	9/6/2007	Present
Eagle Creek Below South Fork Near Alto, NM	08387600	33.3928528	–105.723344	7,600	8	0	8/27/1969	Present
Eagle Cr Nr Alto, NM	08387800	33.3914713	–105.611373	6,838	16	—	10/1/1969	12/31/1980
Rio Ruidoso at Hondo, NM	08388000	33.3834222	–105.27554	5,181	290	—	10/1/1930	9/30/1955
Rio Bonito Near Lincoln, NM	08389055	33.5236111	–105.464444	—	91	—	4/3/1999	9/30/2002
Rio Bonito at Hondo, NM	08389500	33.3889775	–105.27554	5,205	295	—	10/1/1930	9/30/1955
Rio Hondo Above Chavez Canyon Near Hondo, NM	08390020	33.37125	–105.257389	5,160	588	NA	8/21/2008	Present
Rio Hondo at Picacho, NM	08390100	33.3570365	–105.157482	4,945	715	—	12/4/1956	6/30/1962

Source: USGS, 2014c (unless otherwise noted)
[a] Only those USGS stream gages with daily data are shown.
[b] **Bold** indicates gages in key locations selected for additional analysis.
[c] Source: PVWUO, 2001; USGS, 2014a
[d] Located outside region, included to illustrate the water supply entering the region.

USGS = U.S. Geological Survey
ft amsl = Feet above mean sea level
sq mi = Square miles

NA = Not available
— = Data not available from current source(s).

Table 5-4a. USGS Stream Gage Stations

USGS Station [a]							Period of Record	
Name [b]	Number	Latitude	Longitude	Elevation (ft amsl)	Drainage Area (sq mi)	Irrigated Upstream Land [c] (acres)	Start Date	End Date
Chaves County								
Pecos River Ab. Huggins Cr. Nr. Roswell, NM	08385640	33.9153614	–104.278303	3,680	7,800	—	10/27/1964	9/30/1968
Pecos River Below Sixmile Draw Near Roswell, NM	08385643	33.8531405	–104.291914	3,650	6,928	—	10/1/2001	5/31/2003
Pecos River Above Acme, NM	08385648	33.6856451	–104.316079		7,255	—	8/18/1992	5/31/2000
Pecos River Near Acme, NM	08386000	33.5359722	–104.376586	3,510	11,380	20,000	7/1/1937	Present
Rio Hondo at Diamond A Ranch Nr Roswell, NM	08390500	33.3491667	–104.851667	4,190	947	6,500	10/1/1939	Present
Rio Hondo Blw Diamond A Dam Nr Roswell, NM	08390800	33.2998694	–104.721675	3,950	963	6,500	10/1/1963	Present
Rocky Arroyo Ab Two Rivers Res Nr Roswell, NM	08393200	33.2853775	–104.796919	4,059	31	—	5/1/1963	9/30/1980
Rocky Arroyo Blw Rocky Dam, NM	08393300	33.2662125	–104.702195	3,936	65	—	5/1/1963	9/30/1980
Rio Hondo at Roswell, NM	08393500	33.3720438	–104.545802	—	1,071	—	2/19/1981	5/18/1997
No Spring R at Roswell, NM	08393600	33.3964874	–104.54858	3,575	20	—	5/1/1958	12/31/1977
Rio Hondo Near Roswell, NM	08393610	33.408775	–104.471717	3,500	2,900	NA	6/1/1997	Present
Pecos R N Boundary (Blm Wetlands) Nr Dexter, NM	08394024	33.31725	–104.361667	3,430	14,670	NA	10/24/2003	Present
Pecos R S Boundary (Blm Wetlands) Nr Dexter, NM	08394033	33.2683333	–104.354417	3,438	14,731	NA	10/24/2003	Present
Pecos River Near Hagerman, NM	08394100	33.1689958	–104.307186	—	13,630	—	10/1/1983	7/12/1990
Rio Felix at Old Hwy Brd Nr Hagerman, NM	08394500	33.1251075	–104.344963	3,403	932	—	10/1/1939	Present
Pecos River Near Lake Arthur, NM	08395500	32.9893056	–104.320972	3,327	14,760	124,000	8/24/1938	Present

Source: USGS, 2014c (unless otherwise noted)
[a] Only those USGS stream gages with daily data are shown.
[b] **Bold** indicates gages in key locations selected for additional analysis.
[c] Source: PVWUO, 2001; USGS, 2014a

USGS = U.S. Geological Survey
ft amsl = Feet above mean sea level
sq mi = Square miles

NA = Not available
— = Data not available from current source(s).

Table 5-4a. USGS Stream Gage Stations

USGS Station [a]							Period of Record	
Name [b]	Number	Latitude	Longitude	Elevation (ft amsl)	Drainage Area (sq mi)	Irrigated Upstream Land [c] (acres)	Start Date	End Date
Chaves County (cont.)								
Rio Penasco Near Dunken, NM	08397600	32.8815278	–105.178056	5,290	583	NA	10/1/1956	Present
Rio Penasco Near Hope, NM	08397620	32.8367722	–105.069422	4,931	675	NA	2/19/2000	Present
Otero County								
Rio Ruidoso at Ruidoso, NM	08386505	33.3365306	–105.726308	7,160	18	NA	10/30/1998	Present
Eddy County								
Cottonwood Creek Near Lake Arthur, NM	08396000	32.9153892	–104.367184	3,316	199	—	3/1/1932	12/31/1964
Eagle Draw at Artesia, NM	08396025	32.8459456	–104.404407	—	—	—	8/1/1989	5/31/1995
Pecos River Near Artesia, NM	08396500	32.8408611	–104.323833	3,292	15,300	154,000	10/1/1905	Present
Rio Penasco at Dayton, NM	08398500	32.7434472	–104.414131	3,385	1,060	3,000	4/1/1951	Present
Pecos River (Kaiser Channel) Near Lakewood, NM	08399500	32.689375	–104.299219	3,269	19,163	3,000	5/16/1950	Present
Fourmile Draw Nr Lakewood, NM	08400000	32.6726889	–104.368969	3,299	265	NA	10/1/1951	Present
Pecos River Below Mcmillan Dam, NM	08401000	32.5945595	–104.350236	3,238	16,990	—	2/8/1906	9/30/1988
Pecos River Ab Seven Rivers Nr Lakewood, NM	08401100	32.5787258	–104.378848	3,226	17,000	—	5/25/1974	9/30/1987
North Seven Rivers Nr Lakewood, NM	08401150	32.6495586	–104.397183	—	—	—	8/1/1989	2/7/1995
South Seven Rivers Nr Lakewood, NM	08401200	32.5886111	–104.421389	3,280	220	0	10/1/1963	Present
Pecos River Below Brantley Dam Near Carlsbad, NM	08401500	32.5431889	–104.3711	3,191	17,650	173,000	10/1/1971	Present
Rocky Arroyo at Hwy Brd Nr Carlsbad, NM	08401900	32.5060806	–104.374989	3,250	285	220	10/1/1963	Present
Pecos R at Damsite 3 Nr Carlsbad, NM	08402000	32.5112278	–104.333289	3,171	17,980	17,300	8/22/1939	Present
Carlsbad Main Canal at Head near Carlsbad, NM	08403500	32.4903944	–104.252728	3,157	—	25, 000	7/1/1939	Present

Source: USGS, 2014c (unless otherwise noted)

[a] Only those USGS stream gages with daily data are shown.

[b] **Bold** indicates gages in key locations selected for additional analysis.

[c] Source: PVWUO, 2001; USGS, 2014a

USGS = U.S. Geological Survey
ft amsl = Feet above mean sea level
sq mi = Square miles

NA = Not available
— = Data not available from current source(s).

Table 5-4a. USGS Stream Gage Stations

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USGS Station [a]								
Name [b]	Number	Latitude	Longitude	Elevation (ft amsl)	Drainage Area (sq mi)	Irrigated Upstream Land [c] (acres)	Period of Record: Start Date	Period of Record: End Date
Eddy County (cont.)								
Pecos River Below Avalon Dam, NM	08404000	32.4808556	–104.262981	3,130	18,080	198,000	6/1/1951	Present
Pecos River at Carlsbad, NM	08405000	32.4112293	–104.217448	3,080	18,100	—	10/1/1903	12/31/1969
Dark Canyon Draw Near Whites City, NM	08405105	32.2904306	–104.349167	3,544	327	NA	2/3/2002	Present
Dark Canyon at Carlsbad, NM	08405150	32.4033333	–104.229444	3,129	451	2,100 [e]	1/1/1973	Present
Pecos River Below Dark Canyon at Carlsbad, NM	08405200	32.409275	–104.214972	3,075	18,550	198,000	1/1/1970	Present
Blue Springs Above Diversions Nr Whites City, NM	08405450	32.1845889	–104.284497	3,110	—	NA	4/13/2000	Present
Black River Above Malaga, NM	08405500	32.2290889	–104.151853	3,070	343	1,000	1/1/1947	Present
Black River at Malaga, NM	08406000	32.2408667	–104.064686	2,910	350	NA	2/24/2000	Present
Pecos River Near Malaga, NM	08406500	32.2075417	–104.023875	2,896	19,190	202,000	10/1/1914	Present
Pecos River at Pierce Canyon Crossing, NM	08407000	32.1885306	–103.979386	2,889	19,260	202,000	8/1/1938	Present
Pecos River at Red Bluff, NM	08407500	32.0751917	–104.039436	2,850	19,540	202,000	10/1/1937	Present
Delaware River Nr Red Bluff, NM	08408500	32.0231417	–104.054456	2,901	689	NA	10/1/1937	Present

Source: USGS, 2014c (unless otherwise noted)

[a] Only those USGS stream gages with daily data are shown.

[b] **Bold** indicates gages in key locations selected for additional analysis.

[c] Source: PVWUO, 2001; USGS, 2014a

[e] Groundwater withdrawals

USGS = U.S. Geological Survey
ft amsl = Feet above mean sea level
sq mi = Square miles

NA = Not available
— = Data not available from current source(s).

Table 5-4b. USGS Stream Gage Annual Statistics for Stations with 10 or More Years of Record

Page 1 of 2

USGS Station Name [a]	Annual Yield [b] (acre-feet)			Number of Years [c]
	Minimum	Median	Maximum	
Guadalupe County				
Pecos River above Santa Rosa Lake, NM [d]	5,727	68,632	195,399	36
De Baca County				
Pecos River Below Sumner Dam, NM	63,637	122,712	609,508	77
Pecos River Below Taiban Creek Near Fort Sumner,NM	34,244	90,279	172,594	19
Pecos River Near Dunlap, NM	32,072	88,614	168,757	17
Lincoln County				
Rio Ruidoso at Hollywood, NM	2,585	11,113	30,841	60
Eagle Creek Below South Fork Near Alto, NM	36	1,361	3,996	33
Eagle Cr Nr Alto, NM	23	1,542	3,128	11
Rio Ruidoso at Hondo, NM	1,433	8,543	109,753	24
Rio Bonito at Hondo, NM	854	3,392	63,926	24
Chaves County				
Pecos River Near Acme, NM	19,113	104,179	876,724	76
Rio Hondo at Diamond A Ranch Nr Roswell, NM	72	9,882	177,879	74
Rio Hondo Blw Diamond A Dam Nr Roswell, NM	19	4,384	44,814	50
Rocky Arroyo Ab Two Rivers Res Nr Roswell, NM	0	118	3,041	16
Rocky Arroyo Blw Rocky Dam, NM	0	406	6,342	16
Rio Hondo at Roswell, NM	313	6,016	37,501	15
No Spring R at Roswell, NM	0	4	189	19
Rio Hondo Near Roswell, NM	2,686	4,713	13,104	15
Pecos R N Boundary (Blm Wetlands) Nr Dexter, NM	27,728	104,577	132,920	10
Pecos R S Boundary (Blm Wetlands) Nr Dexter, NM	31,493	111,563	172,304	10
Rio Felix at Old Hwy Brd Nr Hagerman, NM	0	5,328	67,908	47
Pecos River Near Lake Arthur, NM	30,986	127,708	1,256,083	75
Rio Penasco Near Dunken, NM	6,508	20,416	34,099	13
Rio Penasco Near Hope, NM	1,173	14,117	23,312	13

Source: USGS, 2014c

[a] Stations with complete years of data only
Bold indicates gages in key locations selected for additional analysis.
[b] Based on calendar years;
[c] Number of years used in calculation of annual yield statistics
[d] Located outside region, included to illustrate the water supply entering the region.

Table 5-4b. USGS Stream Gage Annual Statistics for Stations with 10 or More Years of Record

Page 2 of 2

USGS Station Name [a]	Annual Yield [b] (acre-feet)			Number of Years [c]
	Minimum	Median	Maximum	
Otero County				
Rio Ruidoso at Ruidoso, NM	1,202	4,901	15,420	15
Eddy County				
Cottonwood Creek Near Lake Arthur, NM	200	2,512	22,805	31
Pecos River Near Artesia, NM	29,248	127,708	1,351,646	**77**
Rio Penasco at Dayton, NM	0	491	31,493	61
Pecos River (Kaiser Channel) Near Lakewood, NM	27,366	111,346	237,244	62
Fourmile Draw Nr Lakewood, NM	0	84	30,117	61
Pecos River Below Mcmillan Dam, NM	24,615	61,501	178,820	44
South Seven Rivers Nr Lakewood, NM	0	370	22,805	47
Pecos River Below Brantley Dam Near Carlsbad, NM	40,615	98,351	168,612	34
Rocky Arroyo at Hwy Brd Nr Carlsbad, NM	0	530	39,022	50
Pecos R at Damsite 3 Nr Carlsbad, NM	40,615	101,790	265,044	69
Carlsbad Main Canal at Head near Carlsbad, NM	29,610	73,157	125,029	72
Pecos River Below Avalon Dam, NM	0	12,163	172,015	62
Pecos River at Carlsbad, NM	9,774	80,035	1,387,845	50
Dark Canyon Draw Near Whites City, NM	0	135	17,665	11
Dark Canyon at Carlsbad, NM	0	96	28,307	41
Pecos River Below Dark Canyon at Carlsbad, NM	6,928	28,995	210,023	44
Blue Springs Above Diversions Nr Whites City, NM	5,357	7,674	9,846	13
Black River Above Malaga, NM	3,388	7,819	41,700	67
Black River at Malaga, NM	2,657	6,791	14,262	13
Pecos River Near Malaga, NM	9,267	59,836	1,622,410	76
Pecos River at Pierce Canyon Crossing, NM	10,208	53,537	288,573	64
Pecos River at Red Bluff, NM	10,425	65,555	1,622,410	76
Delaware River Nr Red Bluff, NM	324	4,456	50,605	76

Source: USGS, 2014c

[a] Stations with complete years of data only
Bold indicates gages in key locations selected for additional analysis.
[b] Based on calendar years;
[c] Number of years used in calculation of annual yield statistics

Table 5-5. USGS Stream Gage Average Monthly Streamflow for Stations with 10 or More Years of Record

Page 1 of 4

USGS Station [a]	Complete Years [b]	Average Monthly Streamflow [c] (acre-feet)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Guadalupe County													
Pecos River above Santa Rosa Lake, NM [d]	36	1,162	1,293	3,159	8,158	18,520	13,314	6,896	11,876	8,130	2,621	2,142	1,283
De Baca County													
Pecos River Below Sumner Dam, NM	77	1,267	2,271	14,823	14,145	19,307	24,807	17,958	16,466	15,448	7,676	2,262	967
Pecos River Below Taiban Creek Near Fort Sumner,NM	19	2,064	3,905	12,756	4,177	10,057	17,398	11,840	12,605	11,323	7,869	3,126	2,062
Pecos River Near Dunlap, NM	17	2,072	4,470	12,817	3,009	8,814	17,104	10,972	12,376	11,123	7,349	4,171	2,392
Lincoln County													
Rio Ruidoso at Hollywood, NM	60	677	761	1,358	1,974	1,662	737	843	1,526	1,270	900	718	803
Eagle Creek Below South Fork Near Alto, NM	33	65	85	166	217	176	58	125	185	169	111	78	87
Eagle Cr Nr Alto, NM	11	60	85	145	219	176	37	24	52	98	97	128	102
Rio Ruidoso at Hondo, NM	24	563	563	1,012	1,510	2,038	710	1,086	1,196	2,301	1,523	683	562
Rio Bonito at Hondo, NM	24	100	84	118	549	1,084	417	898	1,010	1,991	777	308	147
Chaves County													
Pecos River Near Acme, NM	76	1,631	2,091	10,994	10,431	15,321	17,390	17,707	14,614	16,348	8,742	3,559	1,824
Rio Hondo at Diamond A Ranch Nr Roswell, NM	74	860	603	680	1,348	1,505	1,201	1,479	2,307	3,012	1,350	835	1,024
Rio Hondo Blw Diamond A Dam Nr Roswell, NM	50	709	555	631	943	751	378	420	1,268	1,298	652	511	693

Source: USGS, 2014c

[a] **Bold** indicates gages in key locations selected for additional analysis.

[b] Monthly statistics are for complete months with locations where 10 or more years of complete data were available.

[c] Data from USGS monthly statistics averaged over the entire period of record, converted to acre-feet (from cubic feet per second) and rounded to the nearest acre-foot.

[d] Located outside region, included to illustrate the water supply entering the region.

USGS = U.S. Geological Survey

Table 5-5. USGS Stream Gage Average Monthly Streamflow for Stations with 10 or More Years of Record

USGS Station [a]	Complete Years [b]	Average Monthly Streamflow [c] (acre-feet)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chaves County (cont.)													
Rocky Arroyo Ab Two Rivers Res Nr Roswell, NM	16	0	0	0	5	0	27	117	165	232	86	0	0
Rocky Arroyo Blw Rocky Dam, NM	16	0	0	0	0	0	250	190	219	300	70	0	205
Rio Hondo at Roswell, NM	15	1,307	953	972	1,214	1,282	629	736	1,560	1,224	1,039	638	1,350
No Spring R at Roswell, NM	19	0	0	0	0	0	16	7	5	1	1	0	0
Rio Hondo Near Roswell, NM	15	473	281	262	477	411	399	547	772	825	469	377	482
Pecos R N Boundary (Blm Wetlands) Nr Dexter, NM	10	3,371	4,306	17,428	4,341	4,222	10,081	9,922	6,251	19,896	8,993	4,628	4,539
Pecos R S Boundary (Blm Wetlands) Nr Dexter, NM	10	4,267	5,282	18,792	4,945	5,114	10,673	10,754	7,355	20,813	9,689	5,540	5,502
Rio Felix at Old Hwy Brd Nr Hagerman, NM	47	168	174	61	87	642	1,524	1,453	1,268	2,706	1,647	298	182
Pecos River Near Lake Arthur, NM	75	5,709	5,131	12,068	11,699	17,144	18,238	18,897	15,376	20,390	14,118	7,216	5,885
Rio Penasco Near Dunken, NM	13	2,053	1,728	1,493	1,025	1,039	1,211	1,576	2,252	1,981	1,721	1,825	2,046
Rio Penasco Near Hope, NM	13	1,207	955	751	464	438	426	1,026	1,856	1,553	959	1,065	1,191
Otero County													
Rio Ruidoso at Ruidoso, NM	15	187	229	523	1,041	747	212	725	985	681	291	166	210
Eddy County													
Cottonwood Creek Near Lake Arthur, NM	31	456	341	316	250	406	313	259	156	260	429	423	459

Source: USGS, 2014c

[a] **Bold** indicates gages in key locations selected for additional analysis.

[b] Monthly statistics are for complete months with locations where 10 or more years of complete data were available.

[c] Data from USGS monthly statistics averaged over the entire period of record, converted to acre-feet (from cubic feet per second) and rounded to the nearest acre-foot.

USGS = U.S. Geological Survey

Table 5-5. USGS Stream Gage Average Monthly Streamflow for Stations with 10 or More Years of Record

USGS Station [a]	Complete Years [b]	Average Monthly Streamflow [c] (acre-feet)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eddy County (cont.)													
Pecos River Near Artesia, NM	77	6,263	5,600	12,240	11,755	19,152	20,298	18,701	14,758	19,976	14,191	7,612	6,434
Rio Penasco at Dayton, NM	61	0	0	0	4	60	576	438	802	522	245	70	0
Pecos River (Kaiser Channel) Near Lakewood, NM	62	4,965	4,658	10,873	8,281	13,383	13,721	15,296	13,399	11,686	8,557	5,398	5,036
Fourmile Draw Nr Lakewood, NM	61	0	0	0	6	56	424	140	757	522	81	0	0
Pecos River Below Mcmillan Dam, NM	44	1,657	1,001	2,578	12,152	8,604	8,667	11,208	11,069	8,696	6,835	1,704	2,087
South Seven Rivers Nr Lakewood, NM	47	0	1	0	6	127	429	87	843	642	40	5	0
Pecos River Below Brantley Dam Near Carlsbad, NM	34	2,235	2,599	4,331	12,596	12,388	12,493	13,033	10,824	9,746	9,790	6,008	3,323
Rocky Arroyo at Hwy Brd Nr Carlsbad, NM	50	0	0	0	315	98	722	303	1,046	1,317	399	23	1
Pecos R at Damsite 3 Nr Carlsbad, NM	69	3,210	3,264	4,863	13,958	11,620	12,958	14,354	14,445	11,880	11,575	5,752	4,190
Carlsbad Main Canal at Head near Carlsbad, NM	74	6,370	6,226	7,455	7,560	7,013	6,595	6,286	5,211	3,498	1,977	280	370
Pecos River Below Avalon Dam, NM	62	464	526	346	563	1,957	2,574	1,882	2,710	2,743	5,156	3,691	1,749
Pecos River at Carlsbad, NM	50	9,843	7,889	7,076	10,529	17,409	21,053	15,161	11,541	16,763	19,841	11,799	10,154
Dark Canyon Draw Near Whites City, NM	11	0	0	0	1,296	11	30	236	27	1,621	14	0	0

Source: USGS, 2014c

[a] **Bold** indicates gages in key locations selected for additional analysis.

[b] Monthly statistics are for complete months with locations where 10 or more years of complete data were available.

[c] Data from USGS monthly statistics averaged over the entire period of record, converted to acre-feet (from cubic feet per second) and rounded to the nearest acre-foot.

USGS = U.S. Geological Survey

Table 5-5. USGS Stream Gage Average Monthly Streamflow for Stations with 10 or More Years of Record
Page 4 of 4

USGS Station [a]	Complete Years [b]	Average Monthly Streamflow [c] (acre-feet)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eddy County (cont.)													
Dark Canyon at Carlsbad, NM	41	0	0	0	669	28	594	100	254	1,623	305	29	0
Pecos River Below Dark Canyon at Carlsbad, NM	44	2,035	1,967	1,800	2,170	2,838	4,814	2,923	1,870	5,780	4,225	6,211	3,227
Blue Springs Above Diversions Nr Whites City, NM	13	676	647	721	654	650	578	591	569	569	604	614	640
Black River Above Malaga, NM	67	627	566	464	612	712	814	811	1,258	1,123	749	542	571
Black River at Malaga, NM	13	478	399	430	639	380	567	745	613	1,106	941	630	631
Pecos River Near Malaga, NM	76	6,099	4,838	3,916	3,680	11,105	8,628	6,050	7,914	13,973	14,184	9,494	7,147
Pecos River at Pierce Canyon Crossing, NM	64	4,533	3,815	3,259	2,990	11,008	8,331	5,762	8,199	13,259	9,412	7,431	5,709
Pecos River at Red Bluff, NM	76	6,293	5,003	4,188	3,911	11,258	9,266	6,548	8,273	14,462	14,480	9,850	7,442
Delaware River Nr Red Bluff, NM	76	184	156	160	321	488	984	817	1,158	1,277	1,503	185	180

Source: USGS, 2014c
[a] **Bold** indicates gages in key locations selected for additional analysis.
[b] Monthly statistics are for complete months with locations where 10 or more years of complete data were available.
[c] Data from USGS monthly statistics averaged over the entire period of record, converted to acre-feet (from cubic feet per second) and rounded to the nearest acre-foot.

USGS = U.S. Geological Survey

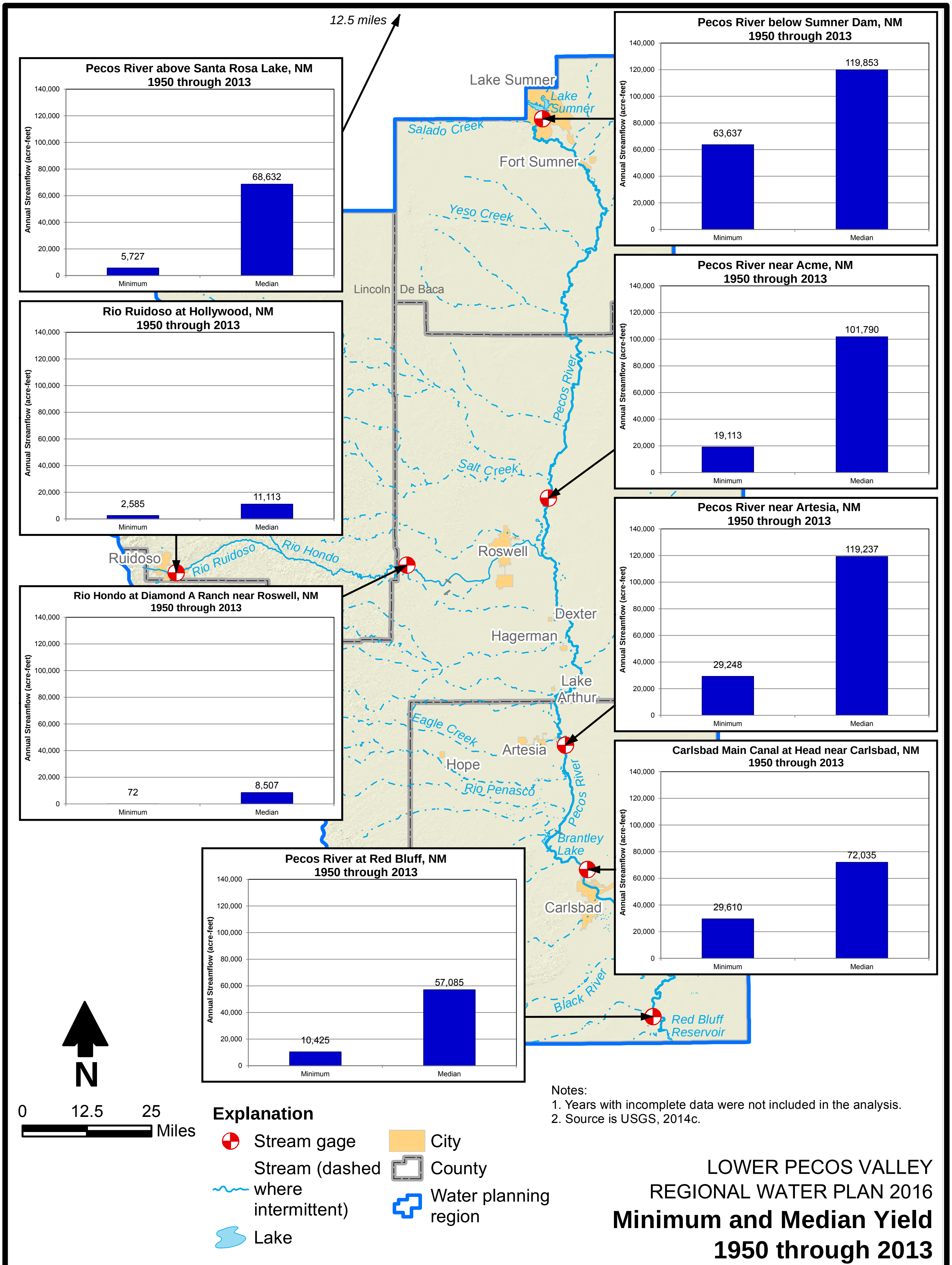
For this water planning update, eight stream gages, shown on Figure 5-7, were analyzed in more detail. These stations were chosen because of their locations in the hydrologic system, completeness of record, and representativeness as key sources of supply. Figure 5-8 shows the minimum and median annual water yield for these gages. Figures 5-9a through 5-9d show the annual water yield from the beginning of the period of record through 2013 for the eight gages.

The northernmost gage, Pecos River above Santa Rosa Lake, is located about 12 miles upstream and outside of the planning region, but it represents the water entering the basin from snowmelt in the Sangre de Cristo Mountains. The streamflow at this gage is highly variable, providing nearly 200,000 acre-feet in years with a good snow pack, and as low as zero in 2013, which followed two very dry years.

As shown in Figure 5-8, over the period from 1950 through 2013, the Pecos River generally gained a significant baseflow from the Puerta Luna reach just north of the planning region, lost about 18,000 acre-feet of flow between Fort Sumner Dam and the gage at Acme, and gained back an equal amount between Acme and Artesia. Most notable on Figures 5-4a and 5-4b is the outlier year of 1941, when 41 inches of precipitation were recorded at Sumner Reservoir and 34 inches at Carlsbad and the resulting flows in the Pecos River (Figure 5-9b) were nearly 1.4 million acre feet at the Artesia gage (10 times the median flow) and exceeded 1.6 million (25 times the median) just above the state line at Red Bluff (Figure 5-9c). Conversely, the severe drought of 2011 through the early fall of 2013 resulted in such meager surface water supplies that no releases to the Texas border were required by the 2003 Pecos Settlement Agreement in the years 2011 and 2012.

Several lakes and reservoirs are present in the planning region (Figure 5-7). Table 5-6 summarizes the characteristics of the larger lakes and reservoirs (i.e., storage capacity greater than 5,000 acre-feet, as reported in the *New Mexico Water Use by Categories 2010* report [Longworth et al., 2013]). Brantley Lake, with a storage capacity of nearly 1,000,000 acre-feet is the largest of the reservoirs. Brantley Dam and Avalon Dam impound water that is released primarily for the use of CID members, the principal users of surface water in the basin, and also for flood control purposes. Water primarily for CID is released from Sumner and Santa Rosa (upstream in the Mora-San Miguel-Guadalupe region) dams in blocks that are delivered to Brantley Lake. In addition to the reservoirs shown in Table 5-6, numerous smaller lakes and reservoirs are present in the region; information on these smaller reservoirs was included in the accepted plan (PVWUO, 2001).

The NMOSE conducts periodic inspections of non-federal dams in New Mexico to assess dam safety issues. Dams that equal or exceed 25 feet in height that impound 15 acre-feet of storage or dams that equal or exceed 6 feet in height and impound at least 50 acre-feet of storage are under the jurisdiction of the State Engineer. These non-federal dams are ranked as being in good, fair, poor, or unsatisfactory condition. Dams with unsatisfactory conditions are those that require immediate or remedial action. Dams identified in recent inspections as being deficient, with high or significant hazard potential, are summarized in Table 5-7.



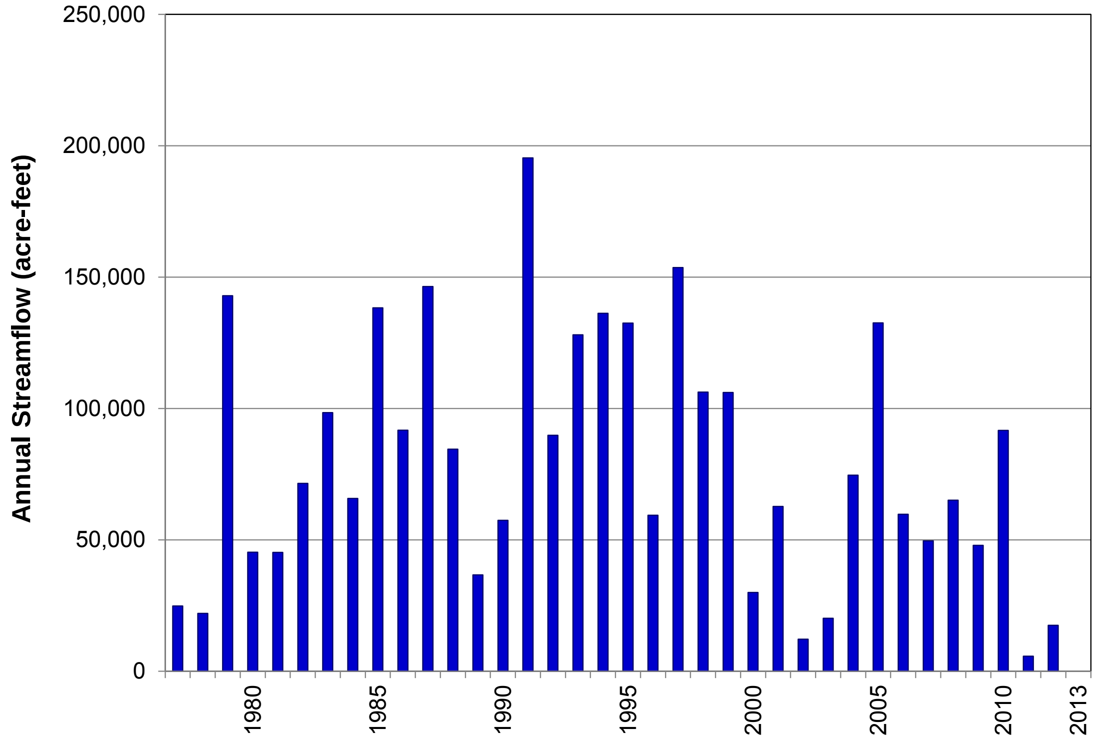
Notes:
1. Years with incomplete data were not included in the analysis.
2. Source is USGS, 2014c.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016
Minimum and Median Yield
1950 through 2013

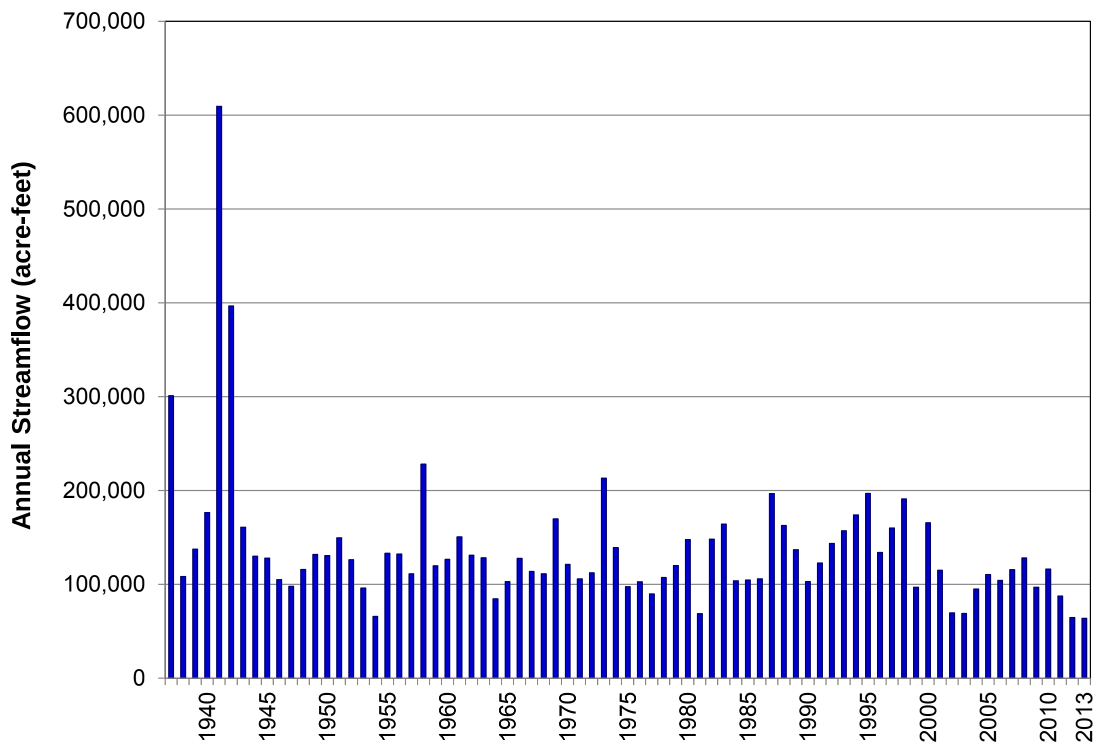
Figure 5-8

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_2016\LOWER_PECOS_VALLEY\FIG5-8_STREAMFLOW.MXD 6/11/2016

Pecos River above Santa Rosa Lake, NM



Pecos River below Sumner Dam, NM



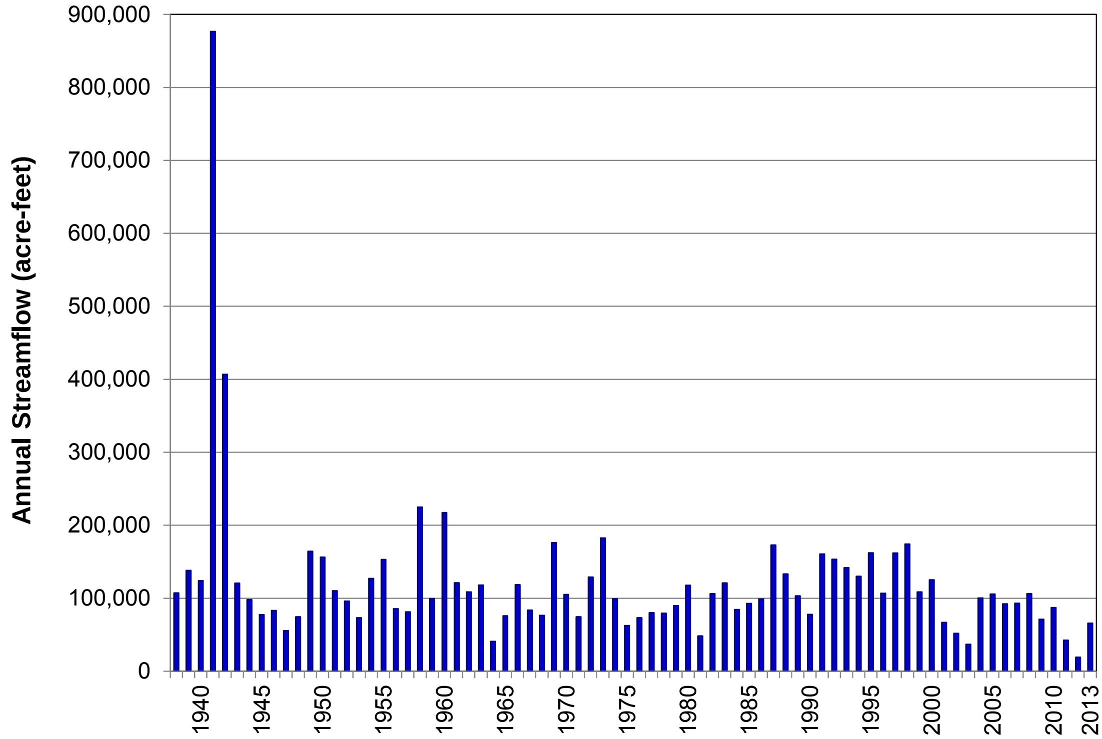
P:_WR12-165\RWPs_2015-2016\810_Lower Pecos Valley\Figures\Fig5-09a_Pecos Santa Rosa-Sumner.docx 6/29/16

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

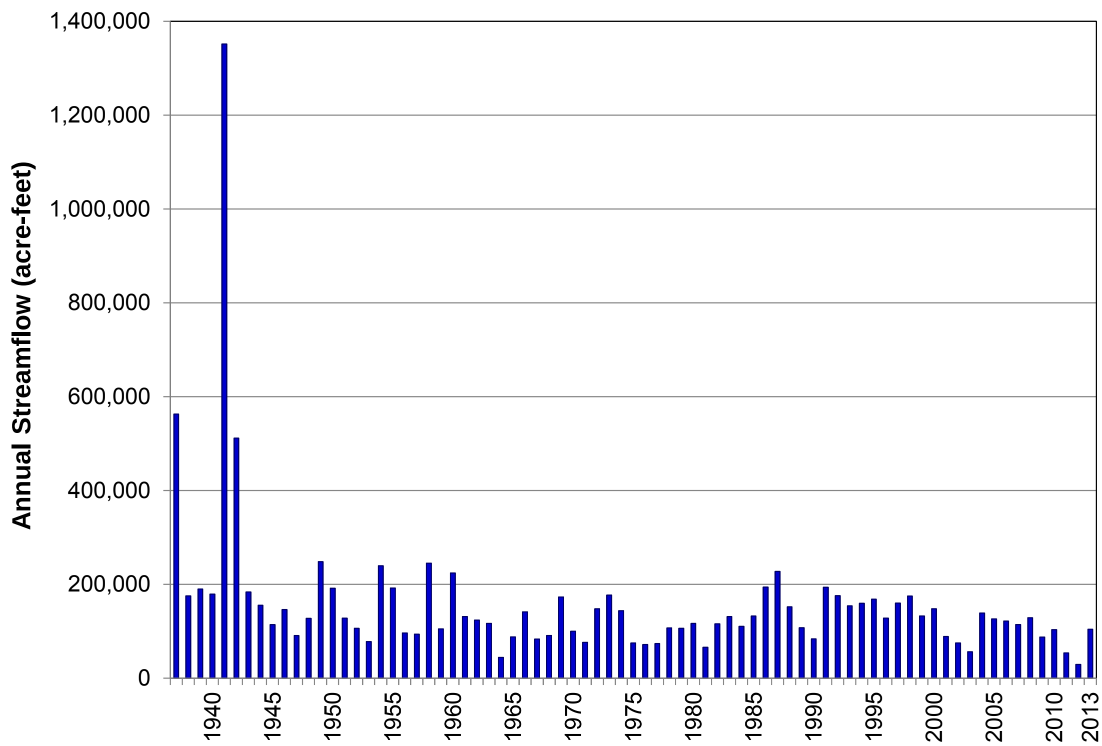
Annual Streamflow for Selected Gaging Stations on the Pecos River

Figure 5-9a

Pecos River near Acme, NM



Pecos River near Artesia, NM

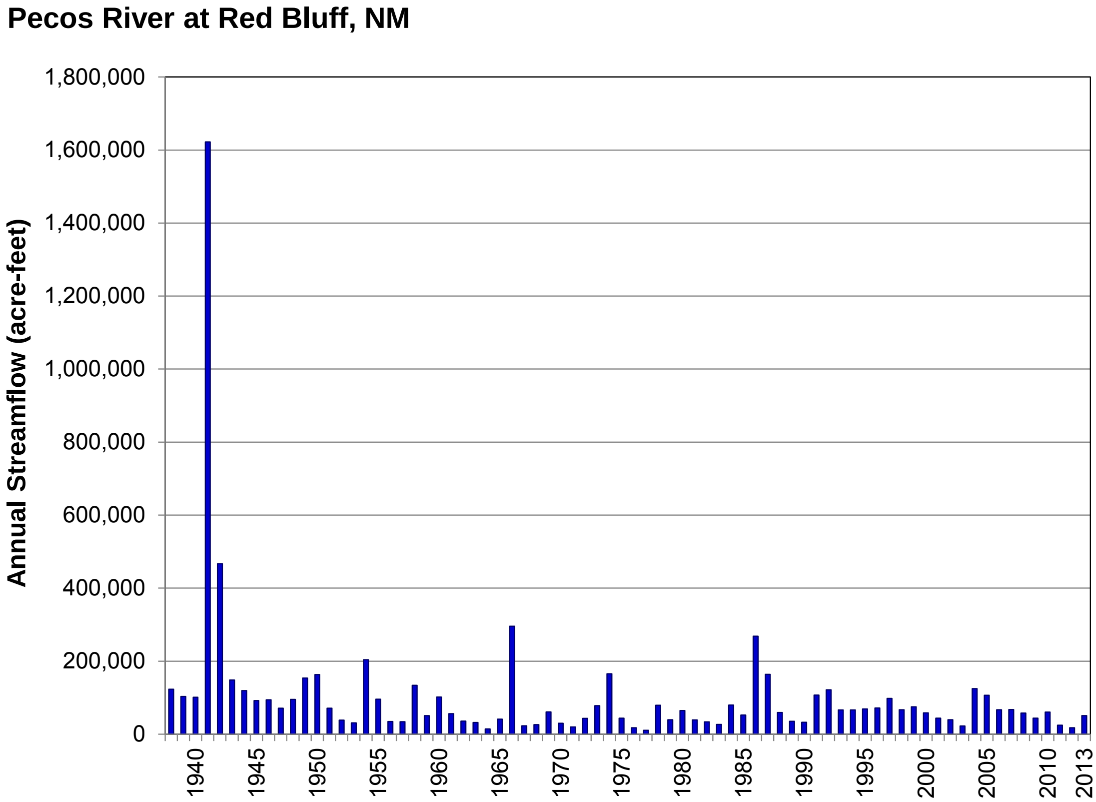


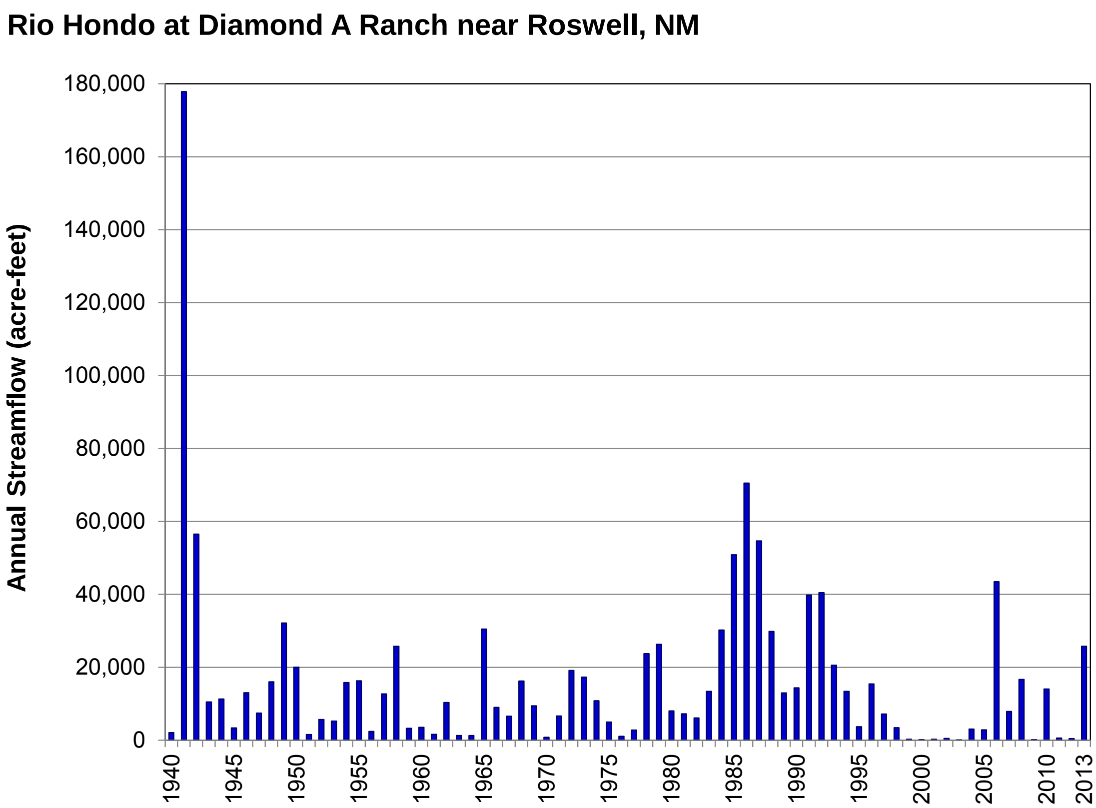
LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Annual Streamflow for Selected Gaging Stations on the Pecos River

Figure 5-9b

P:_WR12-165\RWPs_2015-2016\810_Lower Pecos Valley\Figures\Fig5-09b_Pecos Acme-Artesia.docx 6/29/16





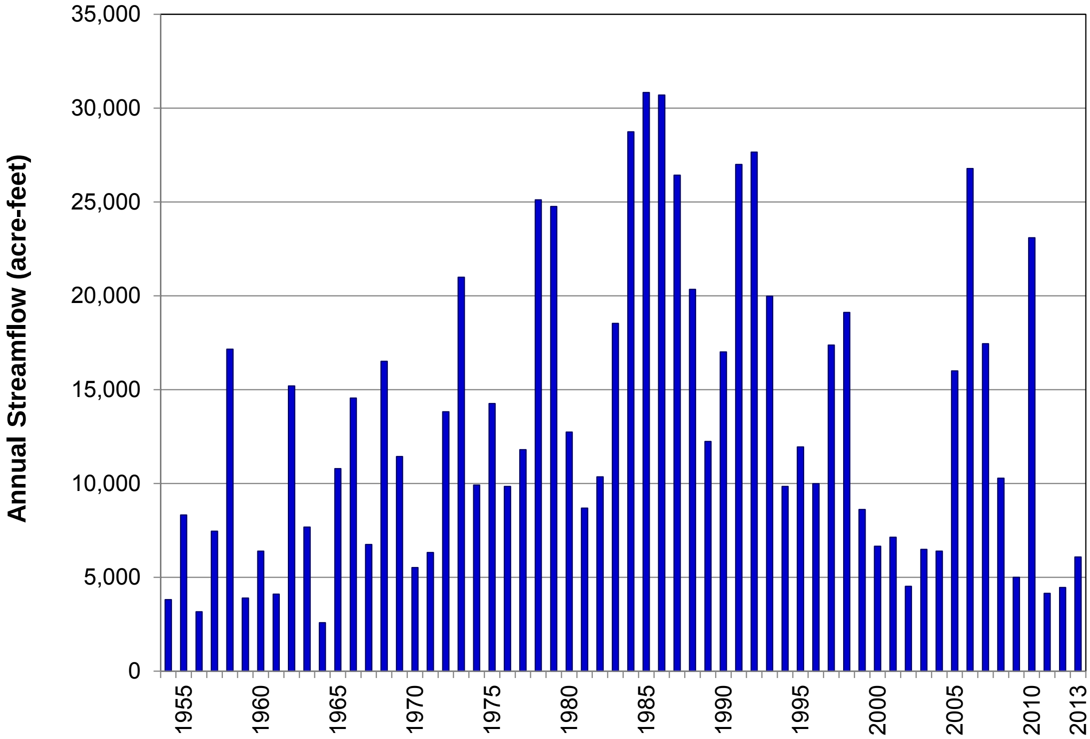
LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Annual Streamflow for Selected Gaging Stations on the Pecos River and Rio Hondo

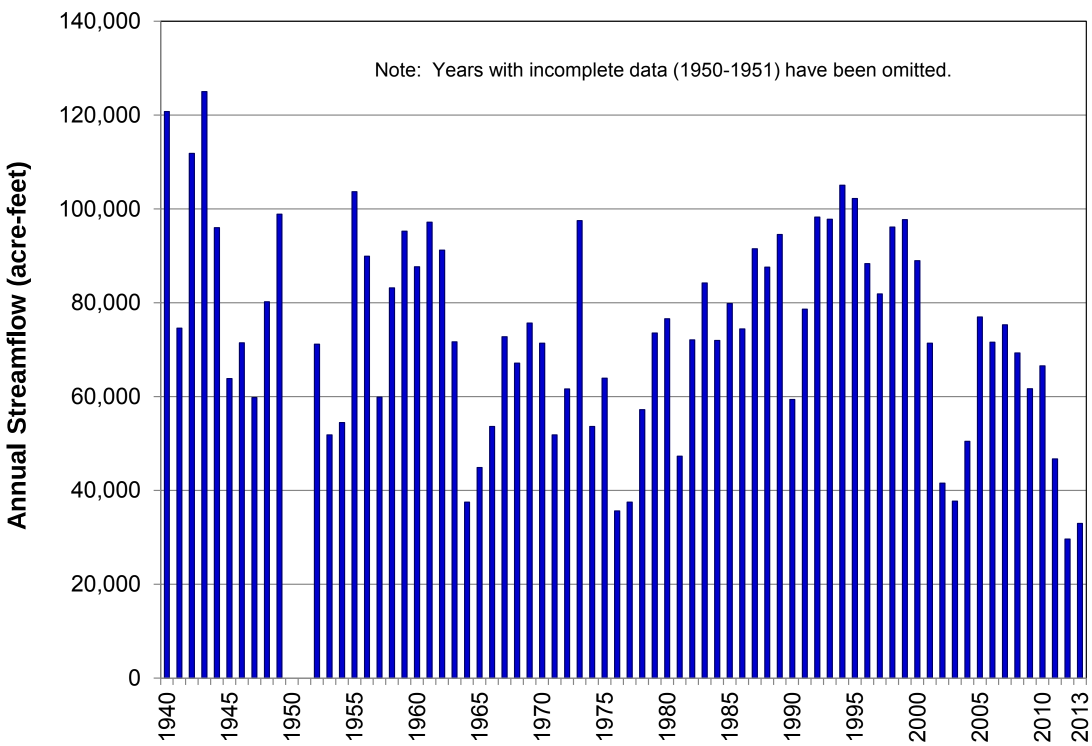
Figure 5-9c

P:_WR12-165\RWPs_2015-2016\810_Lower Pecos Valley\Figures\Fig5-09c_Pecos-Rio Hondo.docx 6/29/16

Rio Ruidoso at Hollywood, NM



Carlsbad Main Canal at Head near Carlsbad, NM



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Annual Streamflow for Selected Gaging Stations on the Rio Ruidoso and Carlsbad Main Canal

Figure 5-9d

Table 5-6. Reservoirs and Lakes (greater than 5,000 acre-feet) in the Lower Pecos Valley Water Planning Region

River	Reservoir	Primary Purpose	Operator	Date Completed	Total Storage Capacity (acre-feet)	Surface Area (acres)	Dam Height (feet)	Dam Length (feet)
De Baca County								
Pecos River	Lake Sumner Reservoir	Flood control	Bureau of Reclamation	1937	227,683	2,828	164	3,675
Eddy County								
Pecos River	Brantley Lake	Flood control	Bureau of Reclamation	1989	966,300	8,600	144	20,850
	Lake Avalon	Irrigation	Bureau of Reclamation	1906	20,000	920	58	1,025

Source: USACE, 1999

Table 5-7. Dams with Dam Safety Deficiency Rankings
Page 1 of 3

Dam	Condition Assess-ment [a]	Deficiency	Hazard Potential [b]	Estimated Cost to Repair ($)
Lincoln County				
Alto Lake Dam	Poor	Spillway and bypass channel capacity 7% of required flood Woody vegetation	High	4,500,000
Bonito Dam	Fair	Spillway capacity 60% of required flood	High	1,500,000
Grindstone Canyon Dam	Fair	Drainage gallery and ventilation system needs rehabilitation	High	1,500,000
Upper Rio Hondo Site No. 1 Dam	Poor	Spillway capacity <12% of required flood	High	2,500,000
Chaves County				
Zuber Draw Site 1 Dam	Fair	Spillway capacity 30% of required flood	High	2,500,000
Zuber Draw Site 2 Dam	Fair	Spillway capacity 40% of required flood	High	50,000
Zuber Draw Site 3 Dam	Fair	Spillway capacity 50% of required flood	High	50,000
Zuber Hollow Reservoir	Poor	Maintenance needed, compliance order to drain No as-built	Low	200,000
Otero County				
Upper Penasco Site 1	Poor	Spillway capacity 60% of required flood Documentation	Significant	250,000
Upper Penasco Site 2	Poor	Spillway capacity 33% of required flood Documentation	High	2,500,000
Upper Penasco Site 3A	Poor	Spillway capacity 22% of required flood Documentation	High	2,500,000
Eddy County				
Artesia Wastewater Re-Use Irrigation Pond 1	Poor	Damaged HDPE liner Inadequate maintenance	Significant	1,000,000
Cass Draw Site 1 Dam	Poor	Spillway capacity 42% of required flood Us slope failure Erosion Woody vegetation Lack of design information	Significant	2,500,000
Cass Draw Site 2 Dam	Poor	Severe embankment erosion Outlet conduit nearly plugged Woody vegetation	Low	100,000
Cottonwood-Walnut Site #6	Poor	Lack of design information	High	100,000

Source: NMOSE, 2014b

[a] Assessment criteria are attached at the end of this table.

[b] Hazard potential classifications are attached at the end of this table.

PMP = Probable maximum precipitation

Table 5-7. Dams with Dam Safety Deficiency Rankings
Page 2 of 3

Dam	Condition Assessment [a]	Deficiency	Hazard Potential [b]	Estimated Cost to Repair ($)
Eddy County (cont.)				
Hackberry Draw Site No. 2 Dam	Poor	Lack of design information	High	100,000
Intrepid Potash West Plant Dam	Fair	Spillway needs repair to restore to original condition Erosion	Low	500,000
Lower Tansil Dam	Poor	Lack of design information	Significant	100,000
SE Storm Drainage Detention Dam	Poor	Spillway capacity 80% of PMF Inadequate maintenance Woody vegetation Lack of design information	Significant	100,000
Six Mile Power Dam	Poor	Concrete deteriorated	Low	400,000
Southwest Laguna Grande Dam	Fair	Extensive repair following inappropriate procedures causing modification of dam	Low	100,000
Upper Tansil Dam	Poor	Maintenance needed Lack of design information	Significant	200,000

Source: NMOSE, 2014b

[a] Assessment criteria are attached at the end of this table.

[b] Hazard potential classifications are attached at the end of this table.

PMP = Probable maximum precipitation

Table 5-7. Dams with Dam Safety Deficiency Rankings
Page 3 of 3

[a] Condition assessment:

	2008 US Army Corps of Engineers Criteria (adopted by NM OSE in FY09)	*NMOSE Spillway Risk Guidelines*
Fair:	No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range [for the owner] to take further action.	Spillway capacity < 70% but ≥ 25% of the SDF.
Poor:	A dam safety deficiency is recognized for loading conditions, which may realistically occur. Remedial action is necessary. A poor condition is also used when uncertainties exist as to critical analysis parameters, which identify a potential dam safety deficiency. Further investigations and studies are necessary.	Spillway capacity < 25% of the SDF.

[b] Hazard Potential Classifications:

High: Dams where failure or mis-operation would likely result in loss of human life.

Significant: Dams where failure or mis-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 located in populated areas with significant infrastructure.

Low: Dams where failure or mis-operation would likely not result in loss of life but may result in minimal economic or environmental losses. Losses would be principally limited to the dam owner's property

5.3 Groundwater Resources

Groundwater accounted for 70 percent of all water diversions in the year 2010 (Longworth et al., 2013).

5.3.1 Regional Hydrogeology

The geology that controls groundwater occurrence and movement within the planning region was described in the accepted *Lower Pecos Valley Regional Water Plan* (PVWUO, 2001) for six UWBs: Fort Sumner, Roswell, Hondo, Peñasco, Carlsbad, and Capitan. A map illustrating the surface geology of the planning region, derived from a geologic map of the entire state of New Mexico by the New Mexico Bureau of Geology & Mineral Resources (2003), is included as Figure 5-10. The accepted water plan (PVWUO, 2001) provides a detailed explanation of the hydrogeology and water uses within each groundwater basin.

Two primary physiographic regions exist within the planning region. From the west to the east, these are:

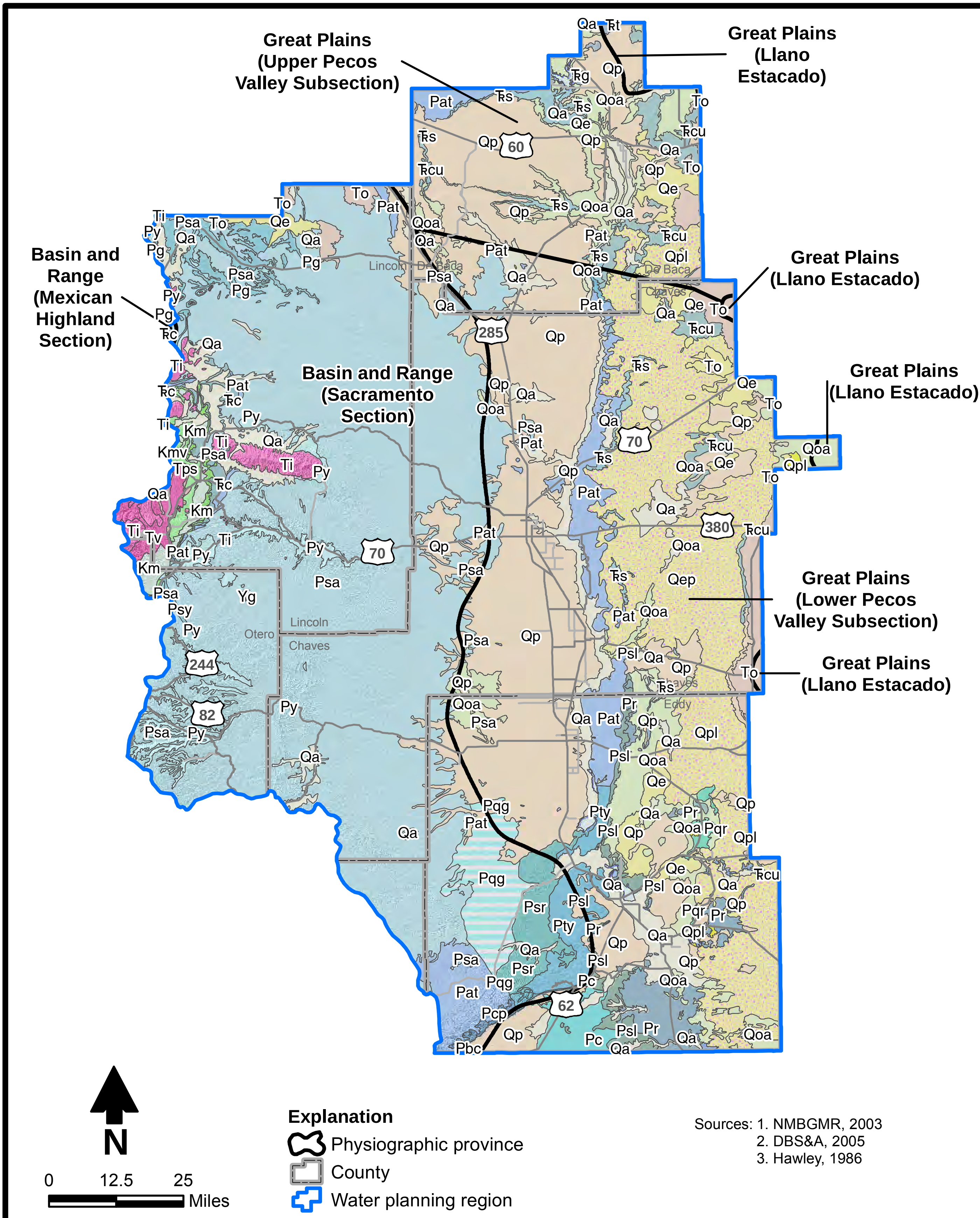
- Basin and Range (Sacramento Section)
- Great Plains (Lower Pecos Valley)

The Great Plains (Llano Estacado or High Plains Subsection) is present in very small areas in the eastern edge of the planning region (Figure 5-10).

In the Lower Pecos Basin (below Sumner Dam), groundwater is readily available from productive aquifers and is heavily used, primarily for irrigation. The principal aquifers are the Roswell artesian aquifer system and the shallow alluvial aquifer in bottom lands near the Pecos River, and the smaller Capitan Reef aquifer and Carlsbad alluvial aquifer located in the Carlsbad area. These Lower Pecos Basin aquifers are described in the following subsections.

5.3.1.1 Fort Sumner Groundwater Basin

The stratigraphy in the Fort Sumner Groundwater Basin consists of pancake layers of geologic formations with the Santa Rosa Sandstone, topped by alluvium that provides the highest yield and best water quality. Deeper formations, such as the San Andres, Glorieta, Artesia Group, and Chinle Formations yield unknown quantities of poor-quality water due to gypsum and other salt deposits within the formations. The alluvium is up to 500 feet thick and can yield fair-quality water at pumping rates up to 1,300 gpm (PVWUO, 2001). The Santa Rosa Sandstone is up to 380 feet thick; yields vary from 15 to 1,000 gpm (PVWUO, 2001).



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Geology and Physiographic Provinces

Figure 5-10a

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_2016\LOWER_PECOS_VALLEY\FIG5-10A_GEOLOGY.MXD 6/4/2016

Geology Explanation

Kdg - Dakota Group
Km - Mancos Shale
Kmv - Mesaverde Group
Pat - Artesia Group
Pbc - Bell Canyon Formation
Pc - Castile Formation
Pcp - Capitan Formation
Pg - Glorieta Sandstone
Pqg - Queen and Grayburg Formations
Pqm - Quartermaster Formation
Pqr - Quartermaster and Rustler Formations
Pr - Rustler Formation
Psa - San Andres Formation
Psl - Salado Formation
Psr - Seven Rivers Formation
Psy - San Andres, Glorieta, and Yeso Formations, undivided
Pty - Tansill and Yates Formations
Py - Yeso Formation
Qa - Alluvium
Qe - Eolian deposits
Qep - Eolian and piedmont deposits
Qoa - Older alluvial deposits of upland plains and piedmont areas, and calcic soils and eolian cover sediments of High Plains region
Qp - Piedmont alluvial deposits
Qpl - Lacustrine and playa deposits
Ti - Tertiary intrusive rocks of intermediate to silicic composition
To - Ogallala Formation
Tps - Paleogene sedimentary units
Tv - Middle Tertiary volcanic rocks
Water - Water
Yg - Mesoproterozoic granitic plutonic rocks
₮c - Chinle Group
₮cu - Upper Chinle Group, Garita Creek through Redonda Formations, undivided
₮g - Garita Creek Formation
₮s - Santa Rosa Formation
₮t - Trujillo Formation

Source: New Mexico, New Mexico Bureau of Geology, 2003

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016
Geology Explanation

Figure 5-10b

5.3.1.2 Roswell Basin

Welder (1983) prepared the most detailed assessment of the Roswell Basin aquifers, which provided the foundation of groundwater modeling for this basin. The Roswell artesian aquifer is an extensive, highly transmissive, limestone aquifer extending from the Pecos River about 20 miles to the west. This aquifer is overlain by a shallow alluvial aquifer extending several miles west from the Pecos River. These aquifers are separated by a thick, semi-confining unit in the southern half of the basin, making the hydraulic connection between the two aquifers poor in this area. In the northern part of the basin near Roswell, the two aquifers are in better hydrologic connection due to thinning or absence of the semi-confining unit.

Estimated average natural recharge to both aquifers is about 300,000 ac-ft/yr (DBS&A, 1995). About two-thirds of the natural recharge that feeds the Roswell artesian aquifer is derived from the Sacramento Mountains to the west. Recharge to the alluvial aquifer also occurs from irrigation return flow.

After metering began in 1967, groundwater diversions from the artesian aquifer system stabilized at a level of about 250,000 ac-ft/yr. Shallow aquifer diversions were about 110,000 ac-ft/yr in the 1990s. The agricultural sector dominates groundwater diversions in the Roswell artesian aquifer (DBS&A, 1995).

Groundwater is under pressure in the Roswell artesian aquifer, and before major development of the aquifer, wells flowed freely at the surface. Groundwater development had resulted in a decline in water levels by as much as 100 feet from the 1920s through the 1950s, but then water levels stabilized and recovered in response to increased precipitation (and recharge) during the 1980s and 1990s (DBS&A, 1995). Summer water levels drop more than 100 feet below winter levels in some areas, indicating that the aquifer is heavily stressed during the summer irrigation season. The extensive development of the Roswell artesian aquifer system has also reduced the amount of water entering the Pecos River as baseflow gain, thereby reducing available surface water supplies for downstream users as compared to historical flows.

5.3.1.3 Hondo Basin

The Hondo Basin is in the headwaters of the Roswell Basin and derives most of the groundwater from the San Andres Formation and alluvium. In some areas, the Glorieta Sandstone produces water suitable for irrigation. Minor amounts of water are derived for domestic and stock uses from the Cub Mountain, Dakota Sandstone, Chinle Shale, Santa Rosa Sandstone, Artesia Group, and Permian Yeso Formation and Tertiary volcanic rocks associated with Sierra Blanca. The Village of Ruidoso has six active wells completed in the Yeso Formation and volcanic rocks (Village of Ruidoso, 2014). Demands for groundwater and surface water have increased in the upper Rio Hondo Basin due to increases in development and population. A comparison of water level data from March 2003 to water levels in 1963 (Donohoe, 2004) indicated a decline in water levels near the Rio Ruidoso.

5.3.1.4 Peñasco Basin

The Peñasco Basin is also in the headwaters of the Roswell Basin and derives most of its groundwater from the San Andres Formation and alluvium. In some areas, the Glorieta Sandstone produces water suitable for irrigation.

5.3.1.5 Capitan Basin

The Capitan Reef is a curved geologic structure, over 100 miles long, 10 to 14 miles wide, composed of limestone and dolomite in which large solution channels and caverns (such as Carlsbad Caverns) have been formed. East of the Pecos River the Capitan Reef extends from the Carlsbad UWB into the Capitan UWB and becomes progressively deeper. Within the Capitan UWB, the Santa Rosa Sandstone and alluvium are the primary sources of water.

5.3.1.6 Carlsbad Basin

The Carlsbad Basin includes the Pecos Valley Alluvium, the Capitan Reef Aquifer and the Permian Castile and Salado Formations. The Pecos Valley Alluvium extends in a narrow strip along the Pecos River from a few miles north of the City of Carlsbad to the mouth of Dark Canyon. In the vicinity of the CID, the saturated thickness of the alluvium reaches 150 feet between Otis and Loving (Bjorklund and Motts, 1959). In the far southwestern part of the aquifer, the saturated thickness is on the order of 50 feet thick (Barroll et al., 2004). The Pecos River is generally considered the eastern limit of the Pecos Valley Alluvium.

The Capitan Reef aquifer is composed of the Carlsbad and Capitan limestones and extends from the Capitan Basin in the east up to the Guadalupe Mountains in the west. The Capitan Reef aquifer is highly transmissive and of good quality west of the Pecos River. East of the Pecos River the reef is less transmissive and the salinity is much higher. Near the City of Carlsbad, a small part of the alluvial aquifer directly overlies the Capitan Reef aquifer, and the two aquifers are hydrologically connected.

West of the Pecos River, where the reef aquifer is not present, the alluvial aquifer is directly underlain by the Permian Castile and Salado formations, which together comprise up to 2,500 feet of evaporite beds. In addition to forming the basal boundary of most of the alluvial aquifer, these units form the southern and northern boundaries of the Pecos Valley Alluvium. The Permian Castile Formation is a source of water for some relatively deep wells in the western part of the basin (Barroll et al., 2004). The Castile Formation and Pecos Valley Alluvium wells are hydrologically connected in the western part of the basin (Barroll et al., 2004)

The Capitan Reef aquifer receives an estimated 10,000 to 20,000 ac-ft/yr of natural recharge from precipitation in the Guadalupe Mountains and seepage from flood flows in Dark Canyon west of Carlsbad (Barroll et al., 2004). Estimated recharge to the Pecos Valley Alluvium from local precipitation is highly variable, depending on climatic conditions; annual values range from near zero to almost 30,000 acre-feet, with an average value of 8,000 acre-feet. In addition, seepage of irrigation water provides about 20,000 to 50,000 ac-ft/yr (36,000 ac-ft/yr average) of recharge to the Pecos Valley Alluvium, predominantly within the CID. Leakage of Pecos River water from Lake Avalon provides about 15,000 ac-ft/yr of recharge to both the Capitan Reef and Pecos Valley Alluvium aquifers north of Carlsbad.

The major groundwater users in this area include irrigators (both CID and non-CID), the City of Carlsbad, and the potash and oil and gas industries. Within CID more than 100 active supplemental wells augment supply when surface flows are not sufficient to provide CID rights holders a full allotment of 3.697 acre-feet per acre. During the recent drought, limited surface supplies resulted in surface water deliveries of only 1.4 and 0.8 acre-feet per acre in 2011 and 2012 respectively, thereby necessitating significant reliance on groundwater supplies. By 2014, increased surface supplies were sufficient to provide a full allotment without the use of supplemental wells. Under the terms of the 2003 Settlement Agreement, when groundwater diversions combined with surface deliveries within a single calendar year exceed CID's maximum allotment of 3.697 acre-feet per acre, CID is required to deliver that excess volume to the NMISC for compact compliance purposes. In addition to supplemental groundwater rights, some CID rights holders own primary groundwater rights for irrigation purposes.

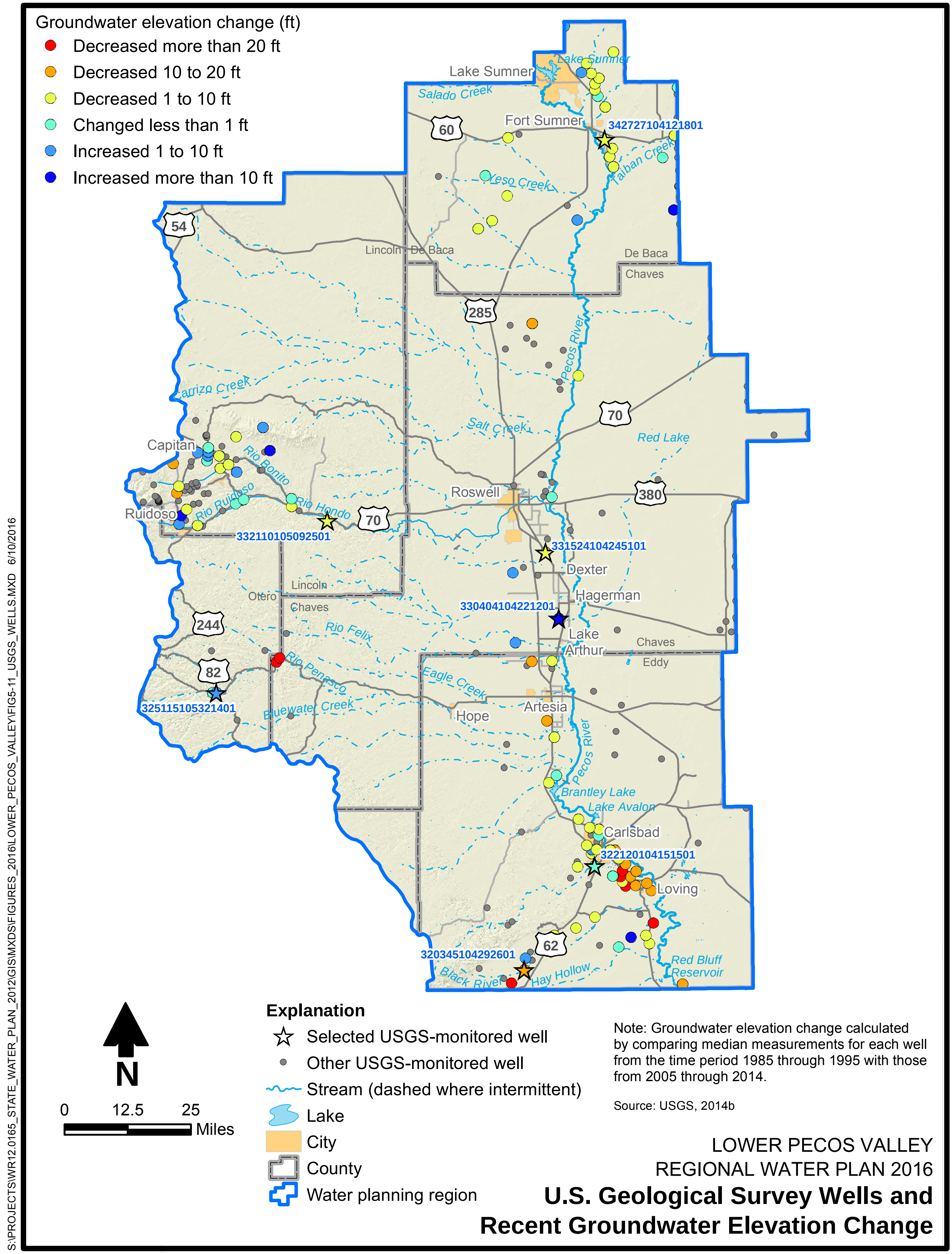
Historically, the Pecos River gained water in this area as base inflow from the Pecos Valley Alluvium and the Capitan Reef aquifer; however, groundwater pumping from the two aquifers has reduced the base inflow of groundwater to the Pecos River. When groundwater levels are drawn down sufficiently, the direction of flow can be reversed altogether, pulling water from the river into the aquifer system. Groundwater depletions in the Carlsbad area, through groundwater pumping in the Carlsbad Basin, directly impact New Mexico's ability to comply with the Pecos River Compact and the U.S. Supreme Court's 1988 Amended Decree. East of the Pecos River within the Carlsbad Basin, the Rustler Formation, Santa Rosa Sandstone and alluvium are the primary sources of water.

5.3.2 Aquifer Conditions

In order to evaluate changes in water levels over time, the USGS monitors groundwater wells throughout New Mexico (Figure 5-11). Hydrographs illustrating groundwater levels versus time, as compiled by the USGS (2014b), were selected for seven monitor wells with longer periods of record and are shown on Figure 5-12.

As reported in the accepted regional water plan (PVWUO, 2001), water level declines vary by location and aquifer:

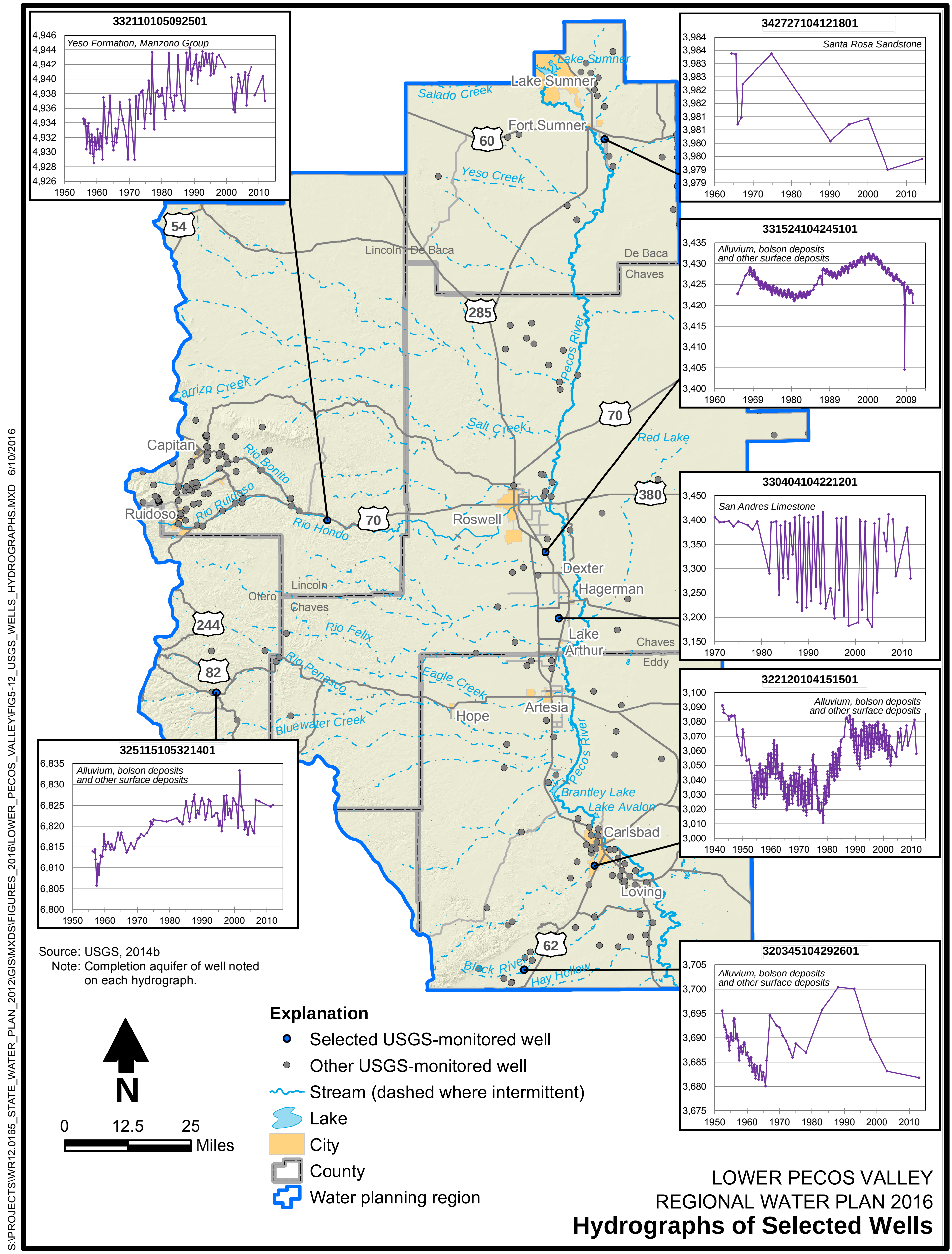
- About half of the wells in the Fort Sumner UWB showed a decline while the other half of the 175 wells showed an increase over a 27-year period from 1964 to 1990. Figure 5-11 shows that most of the wells in the Fort Sumner area are declining between 1 and 10 feet over the 20 year period (between approximately 1990 and 2010). The hydrograph of a well completed in the Santa Rosa Sandstone (Figure 5-12) shows a decline of about 4 feet over a 50-year period from 1960 to 2014.



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

U.S. Geological Survey Wells and Recent Groundwater Elevation Change

Figure 5-11



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016
Hydrographs of Selected Wells

Figure 5-12

- Wells in the Roswell UWB fluctuate seasonally due to irrigation pumping with a trend over time that responds to annual variations in total production, which ranges from 280,000 ac-ft/yr to nearly 450,000 ac-ft/yr (Grigg, 2014). Wells completed in the shallow aquifer (e.g., well 331524104245101, north of Dexter, on Figure 5-12) vary only a few feet from summer to winter (because the aquifer is unconfined and has a high storage coefficient) compared to wells completed in the artesian (confined) aquifer that fluctuate several hundred feet from summer to winter.

- Wells completed in the upland areas such as the Hondo and Peñasco UWBs showed rising water levels during the late 1980s and 1990s in response to higher precipitation during those years. A recent study of the Rio Hondo Basin (Donohoe, 2004) comparing water levels from 2003 with 1963 data from 70 wells indicated a decline in water levels near the Rio Ruidoso but a rise in water levels near the Rio Bonito. Within the Rio Hondo Basin, the rising and declining water levels were highest in the northern part of the study area. The median rise of water levels was 4.0 feet and ranged from 0.08 to 36.4 feet. The median decline of water levels was 3.5 feet and ranged from 0.6 to 162 feet. In the southern part of the basin, the median rise of water levels was 2.2 feet and ranged from 0.5 to 17.1 feet. The median decline in water levels was 1.6 feet and ranged from 0.5 to 26.1 feet. Figure 5-11 shows the variability of decline and rise in water levels over the recent period (approximately 1990 to 2010).

- Wells in the Carlsbad and Capitan UWBs respond rapidly to changes in pumping and recharge. Review of 115 wells in the basins (PVWUO, 2001) showed a decline in 45 of the alluvial wells while water rose in 35 from 1987 to 1993. Of the 31 wells in the Capitan Reef aquifer, 20 showed a decline and 8 showed an increase over the same period. Figure 5-11 shows the variability of decline and rise in water levels over the recent period (approximately 1990 to 2010). Declines are greatest around Loving and Carlsbad.

The aquifers in the planning region are generally recharged through direct infiltration of snow melt and precipitation in the outcrop areas, infiltration from lakes, streams, and canals where the elevation of the lake or stream bottom is above the water table, irrigation return flow, and seepage from septic tanks. The accepted regional water plan did not provide published estimates of recharge in the region, focusing instead on the amount of water in storage. However, recharge in the Roswell Basin has been studied extensively and has been found to vary each year depending on the amount of precipitation. Hantush (1957) studied the “dynamic equilibrium” in specific years and developed an equation for estimating recharge:

$$\text{Recharge (ac-ft/yr)} = 21{,}000 \times \text{Rainfall (3-year average in inches)}$$

The calibration of the Carlsbad groundwater model (Barroll et al., 2004) incorporated different values for recharge each year.

Recharge estimates for the various aquifers in the planning region include:

- Roswell artesian aquifer: 231,900 to 257,000 ac-ft/yr (Summers, 1972; Hantush, 1957)
- Roswell shallow alluvial aquifer: 14,200 to 32,000 ac-ft/yr (Summers, 1972; Hantush, 1957; Morgan, 1938)
- Total recharge to the Roswell Basin: 235,000 to 578,402 ac-ft/yr (Fiedler and Nye, 1933; Hantush, 1957; Saleem and Jacob, 1971; Summer, 1972; DBS&A, 1995)
- Capitan Reef aquifer: 5,800 to 17,315 ac-ft/yr (Barroll et al., 2004)
- Pecos River Basin alluvial aquifers in the Carlsbad Basin: 3,731 to 53,074 ac-ft/yr (Barroll et al., 2004)

The major well fields in the planning region, along with the basins they draw from, are:

- Fort Sumner Municipal Water System (Fort Sumner)
- Ruidoso Water System (Hondo)
- Berrendo Water Users Association (WUA) (Roswell)
- Dexter Municipal Water System (Roswell)
- Hagerman Water System (Roswell)
- Roswell Municipal Water System (Roswell)
- Otis Water Co-op (Carlsbad)
- Carlsbad Municipal Water System (Carlsbad)
- Artesia Domestic Water System (Roswell)
- Artesia Rural Water Co-op (Roswell)

5.4 Water Quality

Assurance of ability to meet future water demands requires not only water in sufficient quantity, but also water that is of sufficient quality for the intended use. This section summarizes the water quality assessment that was provided in the accepted regional water plan and updates it to reflect new studies of surface and groundwater quality and current databases of contaminant sources. The identified water quality concerns should be a consideration in the selection of potential projects, programs, and policies to address the region’s water resource issues.

Surface water quality in the Lower Pecos Valley Water Planning Region is evaluated through periodic monitoring and comparison of sample results to pertinent water quality standards. In general, the water quality is best in the upstream reaches and increases in salinity downstream, particularly beyond Malaga Bend south of Carlsbad. Water quality varies with the rate of flow, exhibiting higher salinities during drought periods. Several lakes and tributaries to the Pecos River within the Lower Pecos River Basin watershed have been listed on the 2014-2016 New Mexico 303(d) list (NMED, 2014a). This list is prepared every two years by NMED and approved by the New Mexico Water Quality Control Commission (NMWQCC) to comply with Section 303(d) of the federal Clean Water Act, which requires each state to identify surface waters within its boundaries that do not meet water quality standards (see Section 4.2.2.1.1).

Section 303(d) further requires the states to prioritize their listed waters for development of total maximum daily load (TMDL) management plans, which document the amount of a pollutant a waterbody can assimilate without violating a state water quality standard and allocates that load capacity to known point sources and nonpoint sources at a given flow. Figure 5-13 shows the locations of lakes and stream reaches with impaired water quality. Table 5-8 provides details of impairment for those reaches.

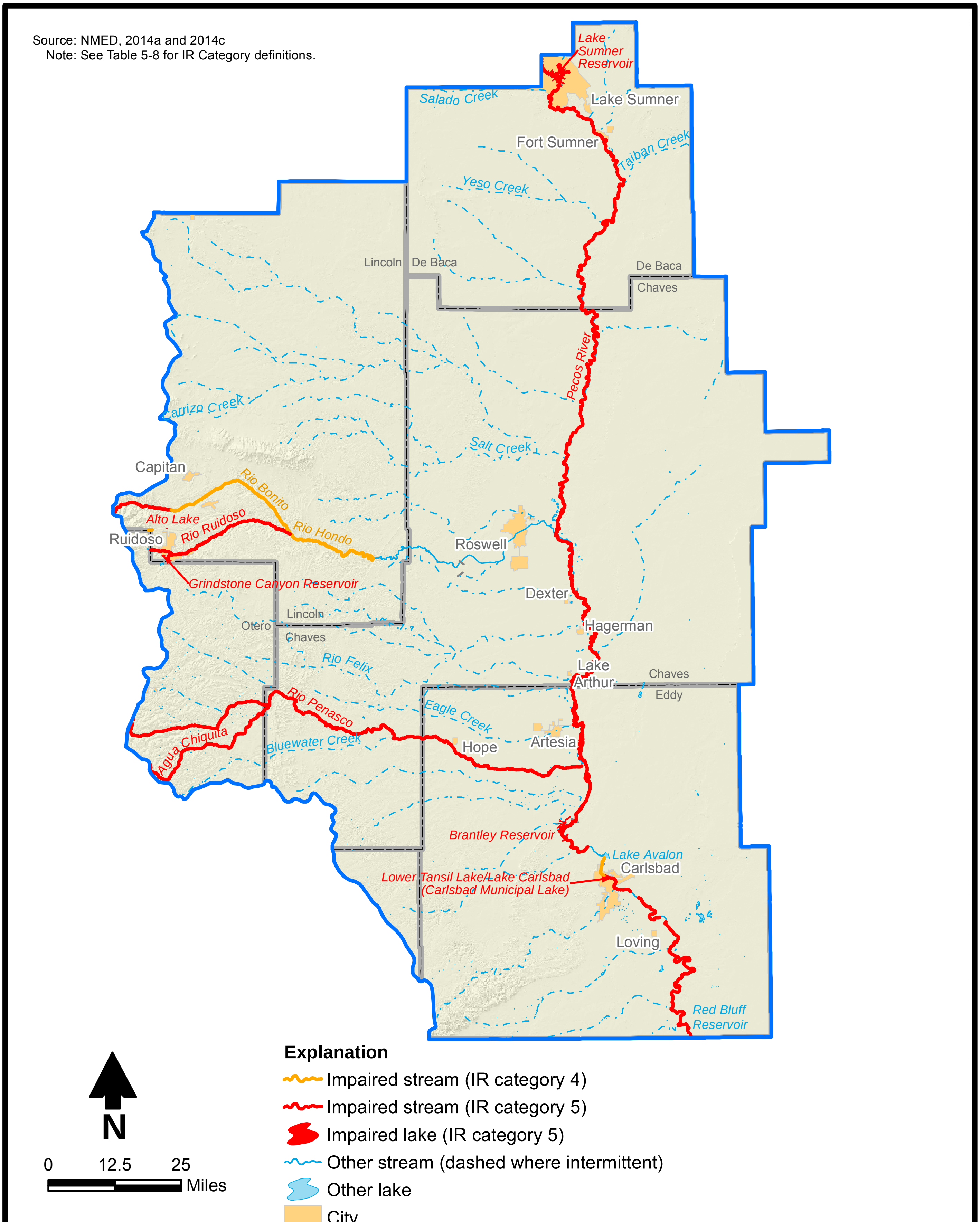
In evaluating the impacts of the 303(d) list on the regional water planning process, it is important to consider that impairments are tied to designated uses. Some problems can be very disruptive to a healthy aquatic community, while others reduce the safety of water recreation or increase the risk of fish consumption. Impairments will not necessarily make the water unusable for irrigation or even for domestic water supply, but the water may need treatment prior to use and the costs of this should be recognized.

Groundwater quality is generally good in the Fort Sumner area and on the west side of the Pecos River throughout the region. East of the Pecos River salinity is high and reaches concentrations of 35,000 parts per million (ppm) (Maddox, 1965). North of Roswell the aquifer has high salinity, particularly in the vicinity of Bitter Lakes (Welder, 1983).

Several types and sources of contaminants that have the potential to impact either surface or groundwater quality are discussed below. Sources of contamination are considered as one of two types: (1) point sources, if they originate from a single location, or (2) nonpoint sources, if they originate over a more widespread or unspecified location. Information on both types of sources is provided below.

5.4.1 Potential Sources of Contamination to Surface and Groundwater

Specific sources that have the potential to impact either surface or groundwater quality in the future are discussed below. These include municipal and industrial sources, leaking underground storage tanks, landfills, and nonpoint sources.



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016
Water Quality-Impaired Reaches

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Figure 5-13

Table 5-8. Total Maximum Daily Load Status of Streams in the Lower Pecos Valley Water Planning Region
Page 1 of 7

Waterbody Name [a] (basin, segment)	Assessment Unit ID	Affected Reach (miles [b])	Probable Sources of Pollutant	Uses Not Fully Supported [c]	Specific Pollutant	IR Category [d]
De Baca County						
Bosque Redondo Lake	NM-9000.B_021	32.65 [d]	Not assessed	—	—	3/3A
Pecos River (Salt Creek to Sumner Reservoir)	NM-2207_00	115.45	Source unknown	MWWAL	Oxygen, dissolved	5/5C
Sumner Reservoir	NM-2210_00	4277.79 [d]	Source unknown	WWAL	Mercury in fish tissue	5/5C
Yeso Creek (Pecos River to headwaters)	NM-98.A_011	46.1	Not assessed	—	—	3/3A
Lincoln County						
Alto Lake	NM-2209.B_30	11.16 [d]	Source unknown	MWWAL	Nutrient/eutrophication Biological indicators	5/5C
Carrizo Creek (Rio Ruidoso to Mescalero Apache bnd)	NM-2209.A_22	2.03	Source unknown	PC	Escherichia coli	5/5A
Eagle Creek (Alto Lake to SF Eagle Creek)	NM-98.A_017	2.85	Not assessed	—	—	3/3A
Grindstone Canyon (Grindstone Rsvr to headwaters)	NM-98.A_009	0.79	Not assessed	—	—	3/3A
Grindstone Canyon Reservoir	NM-2209.B_20	40 [d]	Source unknown	HQColdWAL	Temperature, water	5/5B
Rio Bonito (perennial prt Rio Ruidoso to NM 48 near Angus)	NM-2208_10	31.99	Flow alterations from water diversions	ColdWAL	Low flow alterations	4C

Source: NMED, 2014a

[a] Only waterbodies assigned to IR categories 3 and above are included.
[b] Unless otherwise noted.

[c] ColdWAL = Coldwater aquatic life
HQColdWAL = High quality coldwater aquatic life
IRR = Irrigation
MWWAL = Marginal warmwater aquatic life
PC = Primary contact
WWAL = Warm water aquatic life

[d] Impairment (IR) category definitions are attached as the last page of this table.
[e] Acres

— = No information provided (reach was not assessed).

Table 5-8. Total Maximum Daily Load Status of Streams in the Lower Pecos Valley Water Planning Region

Waterbody Name [a] (basin, segment)	Assessment Unit ID	Affected Reach (miles [b])	Probable Sources of Pollutant	Uses Not Fully Supported [c]	Specific Pollutant	IR Category [d]
Lincoln County (cont.)						
Rio Bonito (perennial prt NM 48 near Angus to headwaters)	NM-2209.A_10	12.98	Source unknown	PC HQColdWAL	Benthic-macroinvertebrate bioassessments Escherichia coli Low flow alterations Temperature, water	5/5C
Rio Hondo (perennial prt North Spring R to Bonney Cyn)	NM-2208_25	20	Not assessed	—	—	3/3A
Rio Hondo (perennial reaches Bonney Canyon to Rio Ruidoso)	NM-2208_30	23.44	Source unknown	ColdWAL	Low flow alterations	4C
Rio Ruidoso (Carrizo Ck to Mescalero Apache bnd)	NM-2209.A_20	4.7	Site clearance (new development or infill) Source unknown Recreational pollution sources Loss of riparian habitat Rangeland grazing Streambank modifications/destabilization	HQColdWAL	Phosphorus (total) Temperature, water Turbidity	5/5A
Rio Ruidoso (Eagle Ck to US Hwy 70 Bridge)	NM-2208_20	8.24	Municipal point source discharges On-site treatment systems (septic) Source unknown Rangeland grazing Flow alterations from water diversions	ColdWAL PC	Escherichia coli Nutrient/eutrophication Biological indicators Turbidity	5/5A
Rio Ruidoso (perennial prt Rio Bonito to Eagle Ck)	NM-2208_21	12.2	Not assessed	—	—	3/3A

Source: NMED, 2014a

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Table 5-8. Total Maximum Daily Load Status of Streams in the Lower Pecos Valley Water Planning Region

Page 3 of 7

Waterbody Name [a] (basin, segment)	Assessment Unit ID	Affected Reach (miles [b])	Probable Sources of Pollutant	Uses Not Fully Supported [c]	Specific Pollutant	IR Category [d]
Lincoln County (cont.)						
Rio Ruidoso (US Hwy 70 Bridge to Carrizo Ck)	NM-2209.A_21	7.58	Source unknown Loss of riparian habitat Rangeland grazing	HQColdWAL	Escherichia coli Nutrient/eutrophication Biological indicators Temperature, water	5/5A
S. Fork Eagle Creek (Eagle Creek to Mescalero Apache bnd)	NM-2209.A_00	0.72	Not assessed	HQColdWAL	Low flow alterations	4C
Chaves County						
Agua Chiquita (perennial portions McEwan Cny to headwaters)	NM-2208_01	22.87	Source unknown	ColdWAL	Turbidity	5/5A
Bitter Lake (Bitter Lake NWR)	NM-9000.B_014	149.4 [d]	Not assessed	—	—	3/3A
Bitter Lake NWR - Unit 15	NM-9000.B_019	97.5 [d]	Not assessed	—	—	3/3A
Bitter Lake NWR - Unit 16	NM-9000.B_017	82.93 [d]	Not assessed	—	—	3/3A
Bitter Lake NWR - Unit 3	NM-9000.B_016	54.2 [d]	Not assessed	—	—	3/3A
Bitter Lake NWR - Unit 5	NM-9000.B_015	52.28 [d]	Not assessed	—	—	3/3A
Bitter Lake NWR - Unit 6	NM-9000.B_020	15.85 [d]	Not assessed	—	—	3/3A
Bitter Lake NWR - Unit 7	NM-9000.B_018	123.5 [d]	Not assessed	—	—	3/3A
Bitter Lake Sink Hole 19	NM-9000.B_112	0.1 [d]	Not assessed	—	—	3/3A
Cottonwood Lake	NM-9000.B_004	0.3 [d]	Not assessed	—	—	3/3A
Figure Eight Lake	NM-9000.B_044	2.2 [d]	Not assessed	—	—	3/3A

Source: NMED, 2014a

[a] Only waterbodies assigned to IR categories 3 and above are included.

[b] Unless otherwise noted.

[c] ColdWAL = Coldwater aquatic life
HQColdWAL = High quality coldwater aquatic life
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[e] Acres

— = No information provided (reach was not assessed).

Table 5-8. Total Maximum Daily Load Status of Streams in the Lower Pecos Valley Water Planning Region

Waterbody Name [a] (basin, segment)	Assessment Unit ID	Affected Reach (miles [b])	Probable Sources of Pollutant	Uses Not Fully Supported [c]	Specific Pollutant	IR Category [d]
Chaves County (cont.)						
Inkwell Lake	NM-9000.B_002	0.4 [d]	Not assessed	—	—	3/3A
Lake Van	NM-9000.B_071	25 [d]	Not assessed	—	—	3/3A
Lea Lake	NM-9000.B_001	17.5 [d]	Not assessed	—	—	3/3A
Mirror Lake	NM-9000.B_003	2 [d]	Not assessed	—	—	3/3A
North Spring R (Rio Hondo to headwaters)	NM-2206.A_40	6.3	Not assessed	—	—	3/3A
Pasture Lake	NM-9000.B_094	0.76 [d]	Not assessed	—	—	3/3A
Pecos River (Rio Felix to Salt Creek)	NM-2206.A_00	47.91	Source unknown	WWAL	DDT PCB in fish tissue	5/5C
Pecos River (Salt Creek to Sumner Reservoir)	NM-2207_00	115.45	Source unknown	MWWAL	Oxygen, dissolved	5/5C
Rio Hondo (perennial prt North Spring R to Bonney Cyn)	NM-2208_25	20	Not assessed	—	—	3/3A
Rio Hondo (perennial prt Pecos R to North Spring R)	NM-2208_26	27.34	Not assessed	—	—	3/3A
Rio Penasco (HWY 24 to Cox Canyon)	NM-2208_00	34.67	Source unknown	ColdWAL	Turbidity	5/5B
Rio Penasco (perennial prt Pecos River to HWY 24)	NM-2206.A_10	63.74	Source unknown	WWAL	Sedimentation/siltation	5/5A

Source: NMED, 2014a

[a] Only waterbodies assigned to IR categories 3 and above are included.

[b] Unless otherwise noted.

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Table 5-8. Total Maximum Daily Load Status of Streams in the Lower Pecos Valley Water Planning Region
Page 5 of 7

Waterbody Name [a] (basin, segment)	Assessment Unit ID	Affected Reach (miles [b])	Probable Sources of Pollutant	Uses Not Fully Supported [c]	Specific Pollutant	IR Category [d]
Otero County						
Bear Canyon Reservoir (Otero)	NM-9000.B_010	2 [d]	Not assessed	—	—	3/3A
Carrizo Creek (Rio Ruidoso to Mescalero Apache bnd)	NM-2209.A_22	2.03	Source unknown	PC	Escherichia coli	5/5A
Rio Penasco (HWY 24 to Cox Canyon)	NM-2208_00	34.67	Source unknown	ColdWAL	Turbidity	5/5B
S. Fork Eagle Creek (Eagle Creek to Mescalero Apache bnd)	NM-2209.A_00	0.72	Not assessed	HQColdWAL	Low flow alterations	4C
Eddy County						
Brantley Reservoir	NM-2205_00	3058.67 [d]	Source unknown	WWAL	DDT	5/5C
Harroun Dam (Ten Mile) Lake	NM-9000.B_048	64.8 [d]	Not assessed	—	—	3/3A
Laguna Quatro	NM-9000.B_059	150 [d]	Not assessed	—	—	3/3A
Laguna Tres	NM-9000.B_061	430 [d]	Not assessed	—	—	3/3A
Laguna Uno	NM-9000.B_066	600 [d]	Not assessed	—	—	3/3A
Laguna Walden	NM-9000.B_062	50 [d]	Not assessed	—	—	3/3A
Lower Tansil Lake/Lake Carlsbad (Carlsbad Municipal Lake)	NM-2203.B_00	136 [d]	Source unknown	WWAL	PCB in fish tissue	5/5C
Pecos River (Avalon Reservoir to Brantley Reservoir)	NM-2204.A_00	6.94	Source unknown	WWAL	DDT	5/5C
Pecos River (Black River to Lower Tansil Lake)	NM-2202.A_00	19.4	Source unknown	WWAL	PCB in fish tissue	5/5C

Source: NMED, 2014a

[a] Only waterbodies assigned to IR categories 3 and above are included.

[b] Unless otherwise noted.

[c] ColdWAL = Coldwater aquatic life
HQColdWAL = High quality coldwater aquatic life
IRR = Irrigation
MWWAL = Marginal warmwater aquatic life
PC = Primary contact
WWAL = Warm water aquatic life

[d] Impairment (IR) category definitions are attached as the last page of this table.

[e] Acres

— = No information provided (reach was not assessed).

Table 5-8. Total Maximum Daily Load Status of Streams in the Lower Pecos Valley Water Planning Region

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Waterbody Name [a] (basin, segment)	Assessment Unit ID	Affected Reach (miles [b])	Probable Sources of Pollutant	Uses Not Fully Supported [c]	Specific Pollutant	IR Category [d]
Eddy County (cont.)						
Pecos River (Brantley Rsvr headwaters to Rio Felix)	NM-2206.A_01	77.9	Source unknown	WWAL	DDT PCB in fish tissue	5/5C
Pecos River (Lake Carlsbad to Avalon Reservoir)	NM-2203.A_00	3.92	Not assessed	WWAL	Low flow alterations	4C
Pecos River (Rio Felix to Salt Creek)	NM-2206.A_00	47.91	Source unknown	WWAL	DDT PCB in fish tissue	5/5C
Pecos River (TX border to Black River)	NM-2201_00	35.54	Source unknown	IRR WWAL	Boron Oxygen, dissolved PCB in fish tissue	5/5C
Rattlesnake Springs (Black River to headwaters)	NM-2202.A_12	39.6	Not assessed	—	—	3/3A
Rio Penasco (perennial prt Pecos River to HWY 24)	NM-2206.A_10	63.74	Source unknown	WWAL	Sedimentation/siltation	5/5A
Six Mile Dam Lake	NM-2202.B_20	93.86 [d]	Not assessed	—	—	3/3A
Unnamed tributary (Hart Cny to S Union Rd)	NM-97.A_020	1	Not assessed	—	—	3/3A
Williams Sink (Eddy)	NM-9000.B_109	210.21 [d]	Not assessed	—	—	3/3A

Source: NMED, 2014a

[a] Only waterbodies assigned to IR categories 3 and above are included.

[b] Unless otherwise noted.

[c] ColdWAL = Coldwater aquatic life
HQColdWAL = High quality coldwater aquatic life
IRR = Irrigation
MWWAL = Marginal warmwater aquatic life
PC = Primary contact
WWAL = Warm water aquatic life

[d] Impairment (IR) category definitions are attached as the last page of this table.

[e] Acres

— = No information provided (reach was not assessed).

Table 5-8. Total Maximum Daily Load Status of Streams in the Lower Pecos Valley Water Planning Region

[d] Impairment (IR) categories are determined for each assessment unit (AU) by combining individual designated use support decisions. The applicable unique assessment categories for New Mexico (NMED, 2013b) are described as follows:

Category 3: No reliable monitored data and/or information to determine if any designated or existing use is attained. AUs are listed in this category where data to support an attainment determination for any use are not available, consistent with requirements of the assessment and listing methodology.

Category 3A: Limited data (n = 0 to 1) available, no exceedences. AUs are listed in this subcategory when there are no exceedences in the limited data set. These are considered low priority for follow up monitoring (NMED, 2013).

Category 4C: Impaired for one or more designated uses, but does not require development of a TMDL because impairment is not caused by a pollutant. AUs are listed in this subcategory if a pollutant does not cause the impairment. For example, USEPA considers flow alteration to be “pollution” vs. a “pollutant.”

Category 5/5A: Impaired for one or more designated or existing uses and a TMDL is underway or scheduled. AUs are listed in this category if the AU is impaired for one or more designated uses by a pollutant. Where more than one pollutant is associated with the impairment of a single AU, the AU remains in IR Category 5A until TMDLs for all pollutants have been completed and approved by USEPA.

Category 5/5B: Impaired for one or more designated or existing uses and a review of the water quality standard will be conducted. AUs are listed in this category when it is possible that water quality standards are not being met because one or more current designated use is inappropriate. After a review of the water quality standard is conducted, a Use Attainability Analysis (UAA) will be developed and submitted to USEPA for consideration, or the AU will be moved to IR Category 5A and a TMDL will be scheduled.

Category 5/5C: Impaired for one or more designated or existing uses and Additional data will be collected before a TMDL is scheduled. AUs are listed in this category if there is not enough data to determine the pollutant of concern or there is not adequate data to develop a TMDL. For example, AUs with biological impairment will be listed in this category until further research can determine the particular pollutant(s) of concern. When the pollutant(s) are determined, the AU will be moved to IR Category 5A and a TMDL will be scheduled. If it is determined that the current designated uses are inappropriate, it will be moved to IR Category 5B and a UAA will be developed. If it is determined that “pollution” is causing the impairment (vs. a “pollutant”), the AU will be moved to IR Category 4C.

5.4.1.1 Municipal and Industrial Sources

As discussed in Section 4.2.2, a person or facility that discharges a pollutant from a point source to a surface water that is a water of the United States must obtain an NPDES permit. An NPDES permit must assure compliance with the New Mexico Water Quality Standards. A person or facility that discharges contaminants that may move into groundwater must obtain a groundwater discharge permit from the New Mexico Environment Department. A groundwater discharge permit ensures compliance with New Mexico groundwater quality standards. The NMWQCC regulations also require abatement of groundwater contamination that exceeds standards.

NPDES-permitted discharges in the planning region are summarized in Table 5-9 and shown on Figure 5-14; details regarding NPDES permits in New Mexico are available on the NMED's website (http://www.nmenv.state.nm.us/swqb/Permits/). The permitted discharges are primarily water and domestic wastewater treatment plants.

A summary list of current groundwater discharge permits in the planning region is provided in Table 5-10; their locations are shown in Figure 5-14. Details indicating the status, waste type, and treatment for discharge permits for industrial and domestic waste can be obtained from the NMED Ground Water Quality Bureau website (https://www.env.nm.gov/gwb/NMED-GWQB-PollutionPrevention.htm#PPSlist).

The more than 19,000 active oil and gas production wells and disposal (injection wells) in the region pose a potential threat to water quality. The nation's only nuclear waste disposal facility (Waste Isolation Pilot Plant) is located east of Carlsbad several thousand feet below the land surface in a salt dome, but it is unlikely to threaten fresh water supplies.

5.4.1.2 Remediation Sites

The accepted regional water plan (PVWUO, 2001) identified five sites in the planning region that were listed by the U.S. EPA (2004) as Superfund sites. One of these sites, the McGaffey & Main Groundwater Plume, is the only one currently listed as a Superfund site (U.S. EPA, 2014). Information regarding this site is provided in Table 5-11.

Sites undergoing investigation or cleanup pursuant to other federal authorities or state authority can be found on the EPA website (https://www.epa.gov/superfund/national-priorities-list-npl-sites-state#NM).

Table 5-9. Municipal and Industrial NPDES Permittees in the Lower Pecos Valley Water Planning Region

Permit No	Municipality/Industry [a]	Permit Type [b]
De Baca County		
NM0023477	Fort Sumner, Village of	Municipal (POTW)
Lincoln County		
NM0029238	CDS Rainmakers/Rancho Ruidoso Valley Estates	Private domestic
NM0029165	Ruidoso City of/Ruidoso Downs WWTP [c]	Municipal (POTW)
NM0028533	Ruidoso, Village of/Alto WTP	Utility
NM0030392	Ruidoso, Village of/Grindstone Dam [d]	Utility
Chaves County		
NM0020311	Roswell, City of [c]	Municipal (POTW)
Otero County		
NM0028886	Sacramento Methodist Assembly	Private domestic
Eddy County		
NM0022268	Artesia, City of/WWTP [c]	Municipal (POTW)
NM0026395	Carlsbad, City of WWTP [c]	Municipal (POTW)
NM0029131	Southwestern Public Service Co./Dc Terminal	Utility

Source: NMED, 2016c

[a] Names appear as listed in the NMED database.

[b] Facilities and activities covered under the 2015 U.S. EPA NPDES Multi-Sector General Permit (MSGP) for Stormwater Discharges Associated with Industrial Activity (e.g., mining, timber products, scrap recycling facilities, as listed in Appendix D of the MSGP [U.S. EPA, 2015]) are not included due to the large number of facilities.

[c] Major discharger, classified as such by the Regional Administrator, or in the case of approved state programs, the Regional Administrator in conjunction with the State Director. Major municipal dischargers include all facilities with design flows of greater than 1 million gallons per day and facilities with U.S. EPA/State approved industrial pretreatment programs. Major industrial facilities are determined based on specific ratings criteria developed by U.S. EPA/State.

[d] NMED lists two outfall locations.

NPDES = National Pollutant Discharge and Elimination System
POTW = Publicly owned treatment works
WWTP = Wastewater treatment plant
WTP = Water treatment plant
U.S. EPA = U.S. Environmental Protection Agency

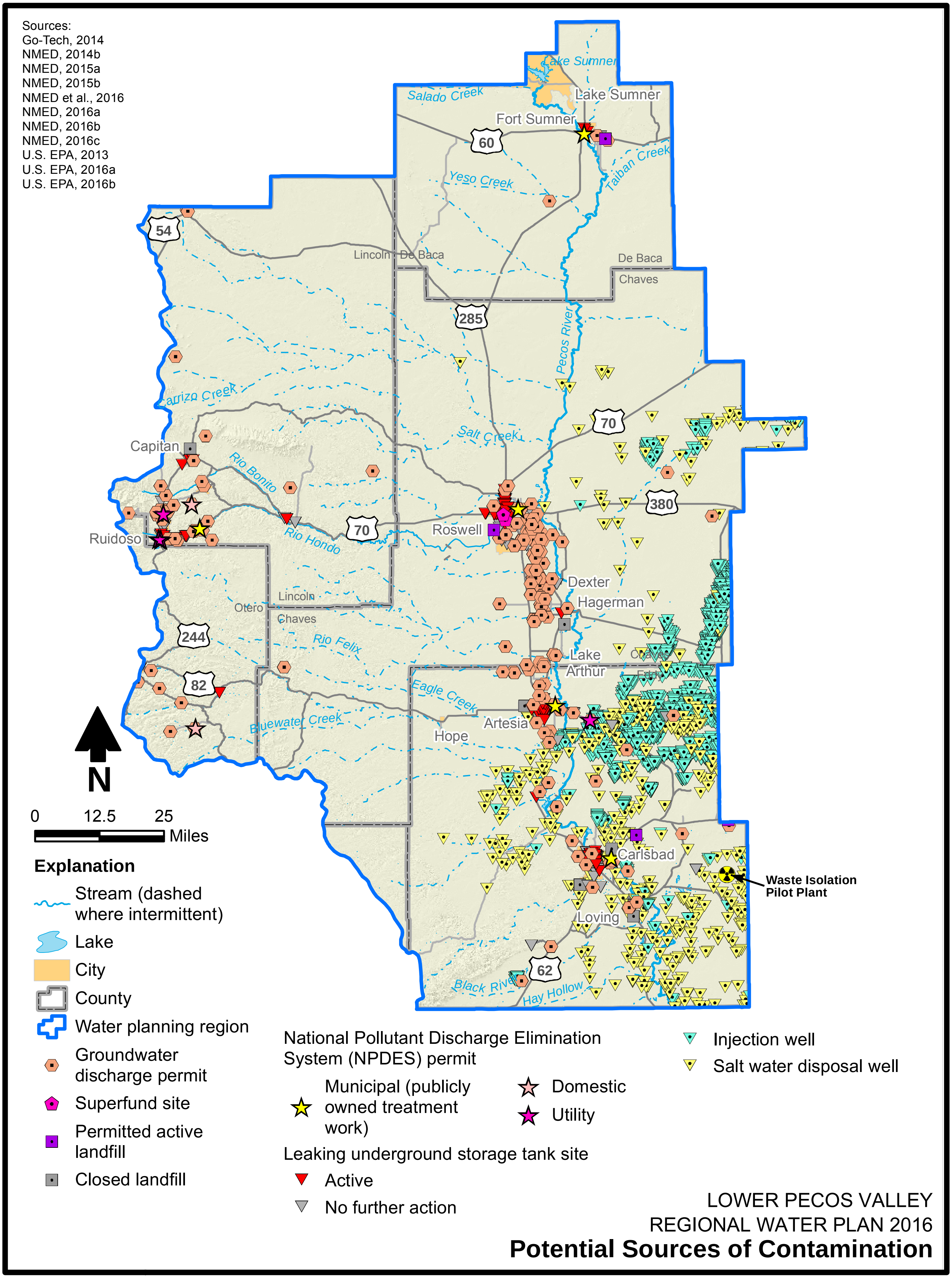

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Figure 5-14

Table 5-10. Groundwater Discharge Permits in the Lower Pecos Valley Water Planning Region

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County	Facility Name [a]	Permit No.	Status [b]	Permitted Discharge Amount (gpd)
DeBaca	Fort Sumner Processing	DP-1538	Active	1,200
Lincoln	Alto Alps Condominiums	DP-118	Active	12,500
	Alto Lakes Water and Sanitation	DP-600	Active	30,000
	Bonita Park Nazarene Camp	DP-1282	Active	36,000
	Capitan (Village of) - WWTP	DP-855	Active	37,500
	Capitan (Village of) - WWTP	DP-1813	Pending	—
	Cook Canyon Ranch	DP-1514	Active	19,500
	Corona (Village of) Waste Water Treatment Plant	DP-1685	Active	20,000
	Eagle Creek WWTP Group	DP-1656	Active	4,000
	Fort Lone Tree	DP-1694	Active	9,750
	Fort Stanton State Monument	DP-1699	Active	7,500
	High Country Lodge	DP-1393	Active	4,750
	Hondo Valley Public Schools	DP-244	Active	6,000
	Kokopelli Mesa Subdivision Wastewater Treatment Facility	DP-1100	Active	40,000
	Little Creek RV Park	DP-1401	Active	8,200
	Rancho Ruidoso Valley Estates Wastewater Treatment Plant	DP-313	Active	40,000
	River Ranch RV Park	DP-1289	Active	12,425
	Ruidoso (Village of) - Wastewater Treatment Plant	DP-509	Active	1,333
	Ski Apache Restaurants And Bars	DP-1768	Active	30,000
Chaves	3-V Dairy	DP-791	Active	72,000

Source: NMED, 2014b, 2016b, NMED et al., 2016

[a] Names appear as listed in the NMED database.

[b] Facilities with an NMED designated status of active or pending are shown. Inactive facilities are not included; they can be identified on the NMED website.

gpd = Gallons per day

— = Not listed on GWQB web site

Table 5-10. Groundwater Discharge Permits in the Lower Pecos Valley Water Planning Region

County	Facility Name [a]	Permit No.	Status [b]	Permitted Discharge Amount (gpd)
Chaves (cont.)	AgGas Pecos 1	DP-1799	Active	350,000
	Arroyo Dairy	DP-764	Active	80,000
	Becks Mobile Home Park	DP-1248	Active	9,300
	Berrendo Middle School	DP-1729	Active	11,840
	Borba Farms LLC	DP-1200	Active	2,500
	Bottomless Lakes State Park	DP-1371	Active	2,125
	Break-Away Dairy	DP-554	Active	120,000
	Breedyk Dairy	DP-742	Active	126,000
	Cheyenne Dairy 2	DP-797	Active	80,000
	Cheyenne Dairy I and III	DP-677	Active	180,000
	Country Acres Mobile Home Park	DP-1428	Active	5,250
	Dan Dee Dairy	DP-533	Active	45,000
	De Groot Dairy	DP-718	Active	120,000
	Dexter (Town of) - Wastewater Treatment Plant	DP-1093	Active	200,000
	Dexter Dairy	DP-606	Active	135,000
	Double Aught Dairy	DP-480	Active	70,000
	El Visto Dairy 2	DP-738	Active	55,000
	Epicenter Dairy	DP-717	Active	48,000
	Gandy Marley Inc Landfarm	DP-1041	Active	52,800
	Gateway Christian School and Church	DP-1307	Active	5,305

Source: NMED, 2014b, 2016b, NMED et al., 2016

[a] Names appear as listed in the NMED database.

[b] Facilities with an NMED designated status of active or pending are shown. Inactive facilities are not included; they can be identified on the NMED website.

gpd = Gallons per day

— = Not listed on GWQB web site

Table 5-10. Groundwater Discharge Permits in the Lower Pecos Valley Water Planning Region
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County	Facility Name [a]	Permit No.	Status [b]	Permitted Discharge Amount (gpd)
Chaves (cont.)	Greenfield Dairy	DP-633	Active	80,000
	Hagerman (Town of) - Wastewater Treatment Plant	DP-760	Active	65,000
	Junior's Mobile RV Park	DP-1766	Active	6,715
	Lake Arthur Municipal Schools	DP-1188	Active	7,500
	Leprino Foods Company	DP-837	Active	950,000
	Nature's Dairy Inc	DP-207	Active	84,000
	Oasis Dairy	DP-208	Active	0
	Par 5 Dairy and Select Milk Producers Inc	DP-1131	Active	80,000
	Par 5 Dairy and Select Milk Producers Inc	DP-1803	Active	300,000
	Pirtle and Sons #2	DP-164	Active	42,000
	Pirtle Farms Dairy	DP-163	Active	13,500
	Queso Grande Dairy	DP-227	Active	84,000
	Rancho Dal Paso LLC	DP-1524	Active	9,900
	Rockhill Dairy	DP-952	Active	80,000
	Roswell (City of) - Waste Water Treatment Plant	DP-281	Active	7,500,000
	Roswell Correctional Center	DP-612	Active	50,000
	Ruan Transport - Hagerman	DP-1728	Pending	—
	Secondwind Dairy	DP-1439	Active	15,000
	Shawnee Dairy	DP-727	Active	81,000
	Side Line Dairy	DP-683	Active	550,000

Source: NMED, 2014b, 2016b, NMED et al., 2016

[a] Names appear as listed in the NMED database.

[b] Facilities with an NMED designated status of active or pending are shown. Inactive facilities are not included; they can be identified on the NMED website.

gpd = Gallons per day

— = Not listed on GWQB web site

Table 5-10. Groundwater Discharge Permits in the Lower Pecos Valley Water Planning Region

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County	Facility Name [a]	Permit No.	Status [b]	Permitted Discharge Amount (gpd)
Chaves (cont.)	Southwind Dairy	DP-776	Active	96,000
	Sunshine Dairy-Dexter	DP-804	Active	24,000
	Three Amigos Dairy	DP-1003	Active	120,000
	Tom Visser Dairy	DP-343	Active	60,000
	Vaz Dairy	DP-707	Active	100,000
	Walnut Creek Municipal Wastewater Treatment Plant	DP-1673	Active	39,000
	Western Dairy Transport	DP-675	Active	5,000
	Wild West Farms	DP-904	Active	155,000
	Winchester Dairy	DP-1141	Active	128,000
	Woodcrest Dairy	DP-635	Active	100,000
	Yorktown Dairy	DP-162	Active	21,000
Otero	Aspendale Baptist Encampment Inc	DP-1758	Active	—
	Cloudcroft Camp	DP-1822	Pending	4,375
	Cloudcroft Ski Area	DP-947	Active	700
	Pine Springs Summer Camp	DP-1772	Active	15,000
	Sacramento Methodist Assembly	DP-114	Active	15,000
	Sivells Baptist Camp	DP-1631	Active	7,760
Eddy	Artesia (City of) - Wastewater Treatment Plant	DP-258	Active	3,000,000
	Artesia Country Club	DP-375	Active	184,800
	Big Eddy Units	DP-1741	Pending	—

Source: NMED, 2014b, 2016b, NMED et al., 2016

[a] Names appear as listed in the NMED database.

[b] Facilities with an NMED designated status of active or pending are shown. Inactive facilities are not included; they can be identified on the NMED website.

gpd = Gallons per day

— = Not listed on GWQB web site

Table 5-10. Groundwater Discharge Permits in the Lower Pecos Valley Water Planning Region

County	Facility Name [a]	Permit No.	Status [b]	Permitted Discharge Amount (gpd)
Eddy (cont.)	Carlsbad Caverns National Park	DP-1264	Active	31,175
	Carlsbad (City of) - Wastewater Treatment Plant	DP-1274	Active	8,500,000
	Carlsbad KOA	DP-1284	Active	9,999
	Carlsbad Mental Health Assoc	DP-1283	Active	3,375
	CEHMM Experimental Algae Propagation Ponds	DP-1634	Active	14,740,000
	Cottonwood Springs Dairy I	DP-734	Active	84,000
	Creekside Dairy	DP-913	Active	56,000
	Holly Energy Partners - Hwy 82 Spill	DP-1710	Active	1
	Intrepid Potash - East Plant	DP-1680	Active	12,620
	J and M Dairy	DP-765	Active	90,000
	Lakeside Dairy	DP-796	Active	90,000
	Loving (Village of) - Wastewater Treatment Plant	DP-1424	Active	325,000
	Mack Energy - Office Waste Disposal	DP-1574	Active	5,000
	Malaga Salt Facility	DP-1754	Pending	—
	Mi Ranchito Packing	DP-681	Active	120
	Mississippi Potash W	DP-1681	Active	4,608,000
	Mosaic Potash Carlsbad Inc	DP-1399	Active	—
	Mosaic Potash Carlsbad Inc	DP-1775	Pending	—
	New Mexico Brantley Lake State Park	DP-564	Active	3,825
	North Park MDWCA	DP-1463	Active	21,000

Source: NMED, 2014b, 2016b, NMED et al., 2016

[a] Names appear as listed in the NMED database.

[b] Facilities with an NMED designated status of active or pending are shown. Inactive facilities are not included; they can be identified on the NMED website.

gpd = Gallons per day

— = Not listed on GWQB web site

Table 5-10. Groundwater Discharge Permits in the Lower Pecos Valley Water Planning Region

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County	Facility Name [a]	Permit No.	Status [b]	Permitted Discharge Amount (gpd)
Eddy (cont.)	SKP Ranch RV Park	DP-1502	Active	6,500
	Town and Country Mobile Home Park	DP-1806	Active	15,865
	Valley View Dairy	DP-921	Active	115,000
	Waste Isolation Pilot Plant	DP-831	Active	23,000
	West Winds Mobile Home Park, LLC	DP-1610	Active	22,500
	White's City	DP-785	Active	35,000

Source: NMED, 2014b, 2016b, NMED et al., 2016

[a] Names appear as listed in the NMED database.

[b] Facilities with an NMED designated status of active or pending are shown. Inactive facilities are not included; they can be identified on the NMED website.

gpd = Gallons per day

— = Not listed on GWQB web site

Table 5-11. Superfund Sites in the Lower Pecos Valley Water Planning Region

Site Location	Site Name [a]	Site ID	EPA ID	Status [b]
Chaves County				
Roswell, NM	Lea and West 2nd St	NMN000607057	—	NPL
	McGaffey & Main Groundwater Plume	NM0000605386	605386	NPL

Source: U.S. EPA, 2016a, 2016b

[a] Names appear as listed in the NMED database.
[b] NPL = National Priorities List

5.4.1.3 Leaking Underground Storage Tanks

Leaking underground storage tank (UST) sites present a potential threat to groundwater, and the NMED maintains a database of registered USTs. Many of the facilities included in the UST database are not leaking, and even leaking USTs may not necessarily have resulted in groundwater contamination or water supply well impacts. These USTs could, however, potentially impact groundwater quality in and near the population centers in the future. UST sites in the Lower Pecos Valley region are identified on Figure 5-14. Many of the UST sites listed in the NMED database require no further action and are not likely to pose a water quality threat. Sites that are being investigated or cleaned up by the State or a responsible party, as identified on Table 5-12, should be monitored for their potential impact on water resources. Additional details regarding any groundwater impacts and the status of site investigation and cleanup efforts for individual sites can be obtained from the NMED database, which is accessible on the NMED website (https://www.env.nm.gov/ust/lists.html).

5.4.1.4 Landfills

Landfills used for disposal of municipal and industrial solid waste often contain a variety of potential contaminants that may impact groundwater quality. Landfills operated since 1989 are regulated under the New Mexico Solid Waste Management Regulations. Many small landfills throughout New Mexico, including landfills in the planning region, closed before the1989 regulatory enactment to avoid more stringent final closure requirements. Other landfills have closed as new solid waste regulations became effective in 1991 and 1995. Within the planning region, there are four operating landfills and five closed landfills (Table 5-13, Figure 5-14).

Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
DeBaca County					
Fort Sumner	Ft Sumner Exxon	1840	1263	318 Sumner Ave	Investigation, Responsible Party
	Hunts Service	643	28629	Star Rd 84 N	Investigation, Responsible Party
	Pueblo Conoco A	4601	1686	11th St and Summer Ave	Investigation, Responsible Party
Lincoln County					
Alto	Chisum #32, Bell Gas 1186	4547	912	101 Sun Valley Rd	Investigation, Responsible Party
	Sullys Food Mrt	90	30805	Hwy 48 and Gavilan	Aggr Cleanup Completed, St Lead, CAF
Capitan	Capitan Mart	635	27217	500 West Smokey Bear Blvd	Cleanup, Responsible Party
	NMDOT Capitan Patrol Yard 42 52, Nmshtd Capitan	2143	29643	131 Main Rd	Cleanup, Responsible Party
	Wakefield Oil Co Capitan	4495	53292	204 E. Smokey Bear Blvd.	Cleanup, Responsible Party
Hondo	Hondo 66 Station, Hondo School	791	28592	Hwy 70 385	Aggr Cleanup Completed, St Lead, CAF
Ruidoso	7-Eleven No18265, Southland	31	26281	Sudderth and Spring St	Aggr Cleanup Completed, Resp Party
	Conoco Plt Stop	4587	1042	115 W Hwy 70	Pre-Investigation, Suspected Release
	Fina 165	2171	1245	418 Michem Dr	Cleanup, Responsible Party
	Gateway Shell/Reese	279	1311	416 Sudderth Dr	Aggr Cleanup Completed, St Lead, CAF
	Gateway Texaco/Reese	387	28295	382 Sudderth Dr	Cleanup, State Lead with CAF
	Gateway, Exxon/Reese	288	28292	453 Sudderth	Aggr Cleanup Completed, St Lead, CAF

Source: NMED, 2014b, 2016a; NMED et al., 2016

[a] Determined according to latitude/longitude information in NMED database. In some cases this information was inconsistent with the facility address, and where such an inconsistency was identified, county and city were instead determined based on the facility address.

[b] Sites with No Further Action status (release considered mitigated) are not included. Information regarding such sites can be found on the NMED website (http://www.nmenv.state.nm.us/ust/lists.html

[c] Information appears as listed in the NMED database.

[d] Pre-Investigation, Suspected Release: Release not confirmed by definition
Pre-Investigation, Confirmed Release: Confirmed release as by definition
Investigation: Ongoing assessment of environmental impact
Cleanup: Physical removal of contamination ongoing
Aggressive Cleanup Completed (Aggr Cleanup Completed): Effective removal of contamination complete
Responsible Party (Resp Party): Owner/Operator responsible for mitigation of release
State Lead: State has assumed responsibility for mitigation of release
CAF: Corrective action fund

Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Lincoln County (cont.)					
Ruidoso (cont.)	Jenning's Oil 2	575	29406	2500 Sudderth	Cleanup, Responsible Party
	Mccarty Construction Co	59	26936	108 Walnut Dr	Aggr Cleanup Completed, Resp Party
Ruidoso Downs	Circle K 1341	4459	1061	601 E Hwy 70	Aggr Cleanup Completed, Resp Party
Chaves County					
Dexter	Allsups 261, Allsups 170	2550	888	200 W First St	Cleanup, Responsible Party
	Crossroads Store	3237	27577	6314 Old Dexter Hwy	Investigation, Responsible Party
Hagerman	Felipe Larez Shell	1357	28443	7675 Hwy 2 and Argile	Investigation, Responsible Party
	Hagerman Allsups, No 251	4035	1388	7670 Wichita Rd Hwy Two and Argile	Cleanup, Responsible Party
	Hagerman Sheriff	1233	1039	106 N Manchester	Aggr Cleanup Completed, Resp Party
Roswell	A Doc Oil Co #6	4672	52518	1617 N Garden	Pre-Investigation, Confirmed Release
	A Doc Oil Co A, Exxon Bell Gas No 239	3536	26322	1112 W 2nd	Cleanup, Responsible Party
	Abc Propane and Gas Co, No 3	4100	52577	813 N Virginia	Investigation, Responsible Party
	Adoc Oil Co - Deshurley	1913	26324	210 E Seventh St	Cleanup, Responsible Party
	Allsups - No268, Brewer Roswell1(Allsup 268)	639	1278	520 E Second	Aggr Cleanup Completed, Resp Party

Source: NMED, 2014b, 2016a; NMED et al., 2016

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[c] Information appears as listed in the NMED database.

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Responsible Party (Resp Party): Owner/Operator responsible for mitigation of release
State Lead: State has assumed responsibility for mitigation of release
CAF: Corrective action fund

Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region

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City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Chaves County (cont.)					
Roswell (cont.)	Allsups #25	4663	1184	1500 N Garden	Pre-Investigation, Confirmed Release
	Allsups 196	3602	891	3107 N Main	Cleanup, Responsible Party
	Allsups 335, Bell Gas/Allsups	2483	876	2501 N Main St	Pre-Investigation, Suspected Release
	Allsups No-289	4418	1466	411 W 2nd	Investigation, Responsible Party
	Antonio Madrid	1065	29226	720 S Main	Aggr Cleanup Completed, Resp Party
	Barajas Inc, Johnnie's Exxon	2485	26847	1302 E 2nd St	Cleanup, Responsible Party
	Bell Warehouse	2346	966	1811 S Garden	Cleanup, Responsible Party
	Century 21 Property	2643	27295	201 N Virginia	Aggr Cleanup Completed, Resp Party
	Chisum Travel Center #30, Prices Truck Stop	4367	30052	5500 N Main	Investigation, Responsible Party
	Circle K 1481	352	1073	3213 N Main	Aggr Cleanup Completed, Resp Party
	Conoco Fifth and Main Service Station	60	27496	426 N Main St	Aggr Cleanup Completed, Resp Party
	Consolidated Bottlers #3	1778	1158	1112 S Main	Cleanup, Responsible Party
	Deep Rock 59	2022	1192	1901 W 2nd	Cleanup, Responsible Party
	Fifth and Main	2951	28018	501 N Main	Cleanup, Responsible Party
	Fina 1	2193	1239	711 S Main	Cleanup, Responsible Party

Source: NMED, 2014b, 2016a; NMED et al., 2016

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Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Chaves County (cont.)					
Roswell (cont.)	Fina 60	3816	1251	1815 Se Main	Investigation, Responsible Party
	Fina Roswell, 2	198	30317	1010 W 2nd St	Aggr Cleanup Completed, Resp Party
	Firestone Tire, store 44C2	177	28048	125 S Main St	Cleanup, Responsible Party
	First Security Bank	3977	50285	1901 N Main	Investigation, Responsible Party
	Flood Control Yard	1230	1037	901 E Alameda	Aggr Cleanup Completed, Resp Party
	Former Chuck Sawey Gulf	2934	27355	224 W 2nd	Cleanup, Responsible Party
	J&J Conoco Service Station	4492	54544	200 West Second St	Cleanup, Responsible Party
	Jerry Pritchard Chevrolet, Walker Chevrolet/2	2420	28742	1600 W Second	Aggr Cleanup Completed, Resp Party
	Lawrence Bros Iga, Furrs Supermarket 908	3562	32018	900 W 2nd	Cleanup, Responsible Party
	Mcclellan Oil	292	29315	2400 N Main	Cleanup, State Lead with CAF
	Mcintyre Oil/Antique Shp	1747	1515	1301 E Second	Cleanup, Responsible Party
	Miller Radiator	3376	29422	109 E First St	Cleanup, Responsible Party
	Murphy Express 8608	4693	54717	3624 North Main St	Investigation, Responsible Party
	NMSHTD-Roswell Patrol Yd	2026	29672	4505 West Second Street	Pre-Investigation, Confirmed Release
	NMSHD-Roswell Patrol	3583	29672	4505 West Second Street	Pre-Investigation, Confirmed Release

Source: NMED, 2014b, 2016a; NMED et al., 2016

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Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Chaves County (cont.)					
Roswell (cont.)	North Main Shell, Brewer Self Serve 6	3410	1752	3001 N Main	Investigation, Responsible Party
	Old Phillips 66	2402	28690	913 N Virginia	Aggr Cleanup Completed, Resp Party
	Payless Gas #448	4611	29887	1409 N Garden	Investigation, Responsible Party
	Price Oil Co	3001	30052	5500 N Main	Investigation, Responsible Party
	RIAC Pumphouse 2	2546	30210	Airport	Pre-Investigation, Confirmed Release
	RIAC Pumphouse 4 Piping	3166	30212	Air Field	Pre-Investigation, Confirmed Release
	RIAC Pumphouse 4	3167	30212	Air Field	Pre-Investigation, Confirmed Release
	RIAC Pumphouse 7	2349	30215	Earl Cummings Loop	Cleanup, Responsible Party
	Roswell Cardlock Bulk Plant	2996	1749	300 E Second St	Cleanup, Responsible Party
	Roswell Chevron, Brewer Selfserv	171	1750	917 N Main	Aggr Cleanup Completed, St Lead, CAF
	Roswell Mitsubushu Volksouthwestagen	2350	30329	2000 W Second St	Cleanup, Responsible Party
	Roswell Park Dept Yard	911	29855	Alameda and Grand	Aggr Cleanup Completed, Resp Party
	Roswell Police Dept Bldg	4078	53140	128 W 2nd St	Pre-Investigation, Confirmed Release
	Roswell Self Serve #1	2673	1751	1609 W Second	Cleanup, Responsible Party
	Roswell Texaco/Bell 1172	918	1867	801 W Second	Cleanup, Responsible Party

Source: NMED, 2014b, 2016a; NMED et al., 2016

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Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Chaves County (cont.)					
Roswell (cont.)	Roswell Wool	2217	30330	212 E Forth	Aggr Cleanup Completed, Resp Party
	Soft Touch Car Wash	3609	32187	1112 N Main St	Cleanup, Responsible Party
	South Main Discount Gas	3547	28621	2012 S Main	Investigation, Responsible Party
	South Main Shamrock	2821	1816	225 S Main	Cleanup, Responsible Party
	Stripes 140, Town & Country #140	2486	1937	1219 E Second	Cleanup, Responsible Party
	Stripes 171, Town & Country 171	2482	1941	2500 N Main	Cleanup, Responsible Party
	Sun Country Food Mart 1, Roswell	4429	1239	711 S Main	Cleanup, Responsible Party
	Sun Country Store 1162	3570	1847	1729 Se Main	Cleanup, Responsible Party
	The Canning	3505	27205	2409 N Main	Cleanup, Responsible Party
	The Greenery	2460	28400	1315 N Main	Cleanup, Responsible Party
	The Greenery Aka Farley's Restaurant	4370	28400	1315 N Main	Aggr Cleanup Completed, Resp Party
	Union Plaza Chevron	2657	31282	920 W 2nd St	Cleanup, Responsible Party
	Union Plaza Conoco	3670	31282	920 W 2nd St	Cleanup, Responsible Party
	Union Plaza Conoco	4476	31282	920 W 2nd St	Investigation, Responsible Party
	United Fuel & Energy SFS #2002	4669	2002	2500 W 2nd	Pre-Investigation, Confirmed Release

Source: NMED, 2014b, 2016a; NMED et al., 2016

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Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Chaves County (cont.)					
Roswell (cont.)	W2HD Second Texaco, Bell Gas Texaco	988	31517	2512 W Second	Aggr Cleanup Completed, Resp Party
	Wagner Ltd	1939	28621	2012 S Main	Pre-Investigation, Confirmed Release
	Wakefield Oil Cardlock	4720	1549	3200 N Main	Pre-Investigation, Confirmed Release
	Wakefield Oil Co 2	4662	51244	311 S Virginia	Pre-Investigation, Confirmed Release
	Wakefield Oil Co 2	4573	51244	311 S Virginia	Pre-Investigation, Confirmed Release
	Wakefield Oil Co 3	4711	51244	311 S Virginia	Pre-Investigation, Confirmed Release
	West City Police Dept	2946	31573	1500 W College	Cleanup, Responsible Party
	Western Petroleum #8863, Gascard	394	1549	3200 N Main	Cleanup, State Lead with CAF
Otero County					
Mayhill	Mayhill Phillips 66	2414	1511	3497 A NM 82	Investigation, Responsible Party
	Mayhill Phillips 66 AST	4397	1511	3497 A NM 82	Investigation, Responsible Party
Eddy County					
Artesia	A Doc Oil Co Bell No. 4	4513	26321	1001 S First	Pre-Investigation, Confirmed Release
	Allsups 1126	1316	854	700 N Eighth	Cleanup, Responsible Party
	Allsups 202	4690	860	800 S First	Pre-Investigation, Confirmed Release

Source: NMED, 2014b, 2016a; NMED et al., 2016

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Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Eddy County (cont.)					
Artesia (cont.)	Allsups 202, Allsups 220	1591	860	800 S First	Pre-Investigation, Confirmed Release
	Allsups 211	4688	861	1303 Hermosa Dr	Pre-Investigation, Confirmed Release
	Allsups 211	4572	861	1303 Hermosa Dr	Pre-Investigation, Confirmed Release
	Baker-Wakefield Oil Company 1	4542	26835	401 N First St	Investigation, Responsible Party
	Boyce Leasing S	2327	27035	1813 N First	Cleanup, Responsible Party
	Brito Andy, 1st St Sta/A-B	1149	27049	1212 N First Street	Cleanup, Responsible Party
	Evans Texaco	3603	27942	115 S First St	Investigation, Responsible Party
	Exxon	437	26321	1001 S First	Cleanup, Responsible Party
	Fina #164	4607	1244	911 W Main	Investigation, Responsible Party
	Fina #9	1317	1254	1412 S First	Cleanup, Responsible Party
	Fina 11	2072	1242	1801 N First	Cleanup, Responsible Party
	Greggs Food Mart Baties No 947	4562	947	1500 N First St	Investigation, Responsible Party
	Halliburton Services	326	28450	2311 1st St	Aggr Cleanup Completed, Resp Party
	James Callaway Dba, A-1 Transmission	2605	28718	1711 N 1st	Cleanup, Responsible Party
	Mesquite Services Inc. (Gas Station)	4407	54398	1800 N Roselawn	Pre-Investigation, Confirmed Release

Source: NMED, 2014b, 2016a; NMED et al., 2016

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Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region

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City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Eddy *County* (cont.)					
Artesia (cont.)	Navajo Refining Company Llc	4571	54634	810 East Main St	Referred to Hazardous Waste Bureau
	NMDOT Artesia Patrol Yard 42 61, Nmshtd Artesia	1921	29642	3101 W Main St	Aggr Cleanup Completed, Resp Party
	26th Street Card System	4715	54556	2514 West Main	Pre-Investigation, Confirmed Release
	Stripes #186	4710	1948	102 N 1st St	Pre-Investigation, Confirmed Release
	Schlumberger Dowell Schlum	39	30504	507 E Richey	Aggr Cleanup Completed, Resp Party
	Western Petroleum #8601	4694	30526	210 E Main	Investigation, Responsible Party
	Western Petroleum #8850, Queen Oil & Gas	2904	1698	606 W Richey	Investigation, Responsible Party
	Western Way Shell	4504	2009	101 N First	Investigation, Responsible Party
	Westside Shell	2416	2014	1301 W Main	Cleanup, Responsible Party
Carlsbad	Allsups - No179	4695	863	1101 W Lea	Investigation, Responsible Party
	Allsups - No190, Allsups 1137	3400	862	1010 S Canal	Investigation, Responsible Party
	Allsups #219	4642	864	920 W Mermod	Investigation, Responsible Party
	Allsups 1128	3693	856	1908 W Church	Cleanup, Responsible Party
	Allsups 269	4306	1834	2301 W Lea	Investigation, Responsible Party
	Als Conoco, Station A	47	1157	713 N Canal	Aggr Cleanup Completed, Resp Party

Source: NMED, 2014b, 2016a; NMED et al., 2016

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Table 5-12. Leaking Underground Storage Tank Sites in the Lower Pecos Valley Water Planning Region
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City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Eddy County (cont.)					
Carlsbad (cont.)	Bell Gas 103, Carl Shortys	22	1796	933 N Canal	Aggr Cleanup Completed, Resp Party
	Bell Gas 62 - 2	3616	962	824 W Mermod	Investigation, Responsible Party
	Carlsbad Exxon, Cliffs Exxon	1820	27426	106 W Greene	Aggr Cleanup Completed, Resp Party
	Carlsbad Self Serve # 3	4305	1023	903 W Pierce	Cleanup, Responsible Party
	Carlsbad Self Serve 1	3539	813	401 S Canal	Aggr Cleanup Completed, Resp Party
	Church Street Allsups	2417	1053	102 E Church	Cleanup, Responsible Party
	Church Street/R&R Chevron	2345	27359	803 N Canal	Investigation, Responsible Party
	Eddies Shell	449	29889	614 N Canal	Cleanup, State Lead with CAF
	La Huerta Allsups	3957	1451	1401 N Canal	Cleanup, Responsible Party
	La Huerta Allsups	4383	1451	1401 N Canal	Cleanup, Responsible Party
	Lakeside Chevron Self Service	4051	29012	102 E Greene St	Cleanup, Responsible Party
	Lea Land Inc	4709	54547	6387 Hobbs Hwy Mile Marker 64	Pre-Investigation, Confirmed Release
	Mail Service Center, Circle K 286	943	27371	522 W Mermod St	Investigation, Responsible Party
	North Canal Shell Texaco Hood	458	29691	821 N Canal	Cleanup, Responsible Party
	Northgate Chevron Food Mart - No 24	4676	1551	1311 W Pierce	Pre-Investigation, Confirmed Release
	PDQ Photo Lab and Studio	1750	29889	614 N Canal	Cleanup, State Lead with CAF

Source: NMED, 2014b, 2016a; NMED et al., 2016

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City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Eddy County (cont.)					
Carlsbad (cont.)	Ross Hyden Motors	1935	30311	1044 N Canal	Aggr Cleanup Completed, Resp Party
	Seven Rivers	1772	1792	5161 Seven Rivers Hwy	Cleanup, Responsible Party
	Smith SK, Carlsbad Welding	115	30647	501 S Main	Aggr Cleanup Completed, Resp Party
	South Canal Texaco	3257	30674	1502 S Canal	Cleanup, Responsible Party
	Tommy Horn , Phil Carrell Chevrolet Buick	3771	31148	1108 W Pierce St	Cleanup, Responsible Party
	United Fuel & Energy Corp Sfs 1499	4575	1499	508 S Main	Cleanup, Responsible Party
	Western Petroleum #8665	4698	1699	3202 S Canal	Investigation, Responsible Party
Loving	Allsups 220, Allsups #1141	2224	866	105 N 8th St	Cleanup, Responsible Party
	Drifter #1	4551	1488	100 N 8th	Investigation, Responsible Party
	Loving Truck Stop	1199	1488	100 N 8th	Investigation, Responsible Party

Source: NMED, 2014b, 2016a; NMED et al., 2016

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Table 5-13. Landfills in the Lower Pecos Valley Water Planning Region

County	Landfill Name [a]	Landfill Operating Status	Landfill Closure Date
De Baca	De Baca County Solid Waste Facility	Open	NA
Lincoln	Capitan Landfill	Closed	—
Chaves	Roswell	Open	NA
Eddy	Artesia Landfill	Closed	—
	Carlsbad Landfill	Closed	—
	Dark Canyon Landfill	Closed	—
	Loving Landfill	Closed	—
	Sand Point	Open	NA

Sources: NMED, 2014b, 2015a, 2015b; Shuman, 2013
[a] Names appear as listed in the NMED database.

NA = Not applicable
— = Information not available

5.4.1.5 Nonpoint Sources

A primary water quality concern in the planning region is groundwater contamination due to septic tanks. In areas with shallow water tables or in karst terrain, septic system discharges can percolate rapidly to the underlying aquifer and increase concentrations of (NMWQCC, 2002):

- Total dissolved solids (TDS)
- Iron, manganese, and sulfides (anoxic contamination)
- Nitrate
- Potentially toxic organic chemicals
- Bacteria, viruses, and parasites (microbiological contamination)

Because septic systems are generally spread out over rural areas, they are considered a nonpoint source. Collectively, septic tanks and other on-site domestic wastewater disposal systems constitute the single largest known source of groundwater contamination in New Mexico (NMWQCC, 2002), with many of these occurrences in areas with shallow water tables.

Other nonpoint sources of pollutants that are concerns for surface water quality in the planning region include fertilizer and pesticides from farms.

One approach to addressing nonpoint source pollution is through Watershed Based Planning or other watershed restoration initiatives that seek to restore riparian health and to address sources of contamination. NMED encourages cooperative planning efforts in watersheds where TMDLS are established (https://www.env.nm.gov/swqb/wps/WBP/index.html). In the Lower Pecos

Valley region, the Pecos River Basin Water Salvage Project was initiated in 1967 through the Bureau of Reclamation to control salt cedar growth from Sumner Dam to the New Mexico-Texas state line. While the initial intent was to salvage water thought to be lost to evaporation, the project has support from environmental groups who seek to restore riparian areas to a more biologically diverse ecosystem. The accepted water plan (PVWUO, 2001) identified 462,000 acres in need of restoration for the purpose of reducing the risk of catastrophic wildfire and the associated nonpoint source pollution of sediment and ash.

In 2014 the Mescalero Apache Tribe Watershed Restoration Project began with the goal of treating 600 acres within the Lower Pecos Valley and Tularosa, Salt and Sacramento water planning regions. Mechanical equipment is being used to reduce overly dense fuel stands to reduce the threat of catastrophic wildfire while promoting forest health in three critical watershed areas on tribal land.

In addition, according to EPA's Surf Your Watershed (U.S. EPA, 2015), several citizen-based groups have been or are working on addressing watershed health:

- The Watershed Defense Association is working on restoration and conservation projects in the Arroyo Del Macho, Gallo Arroyo, and Rio Hondo watersheds in order to protect downstream water right holders and private property rights. The group is dedicated to restoring the watershed and floodplains with the goal of retaining and protecting river flows and preserving the quality and quantity of river, irrigation, wildlife, and domestic drinking water for all downstream inhabitants.

- The Sonterra Watershed Management Area Committee is working on the Rio Hondo Watershed to preserve and enhance the quality of the Upper Hondo watershed, which includes the land, water, vegetation, and general environment surrounding and including the properties of the Ranches of Sonterra. Preserving and enhancing the quality of the watershed include issues of fire safety, forest health, groundwater maintenance, invasive vegetation, and river water quality and flow, all for the benefit of the public welfare.

- The Cloudcroft Elementary Fourth Grade has monitored water quality in the Rio Peñasco since 1996.

Several entities in the region have received Collaborative Forest Restoration Program (CFRP) funding (USFS, 2015), including:

- The South Central Resource Conservation and Development Council, Inc. for two projects: the Ruidoso WUI Interagency Fuel Reduction and Prescribed Fire Implantation Project (2001, 2013), the Restoration Strategy and Payment for Ecosystem Services in the Rio Ruidoso Watershed (2010).

- Eastern New Mexico University (ENMU)-Ruidoso for Implementation of Forest Treatments in Mexican Spotted Owl Habitat.

5.5 Administrative Water Supply

The *Handbook* describes a common technical approach (referred to there as a *platform)* for analyzing the water supply in all 16 water planning regions in a consistent manner. As discussed in the Handbook (NMISC, 2013), many methods can be used to account for supply and demand, but some of the tools for implementing these analyses are available for only parts of New Mexico, and resources for developing them for all regions are not currently available. Therefore, the State has developed a simple method that can be used consistently across all regions to assess supply and demand for planning purposes. The use of this consistent method will facilitate efficient development of a statewide overview of the balance between supply and demand in both normal and drought conditions, so that the State can move forward with planning and funding water projects and programs that will address the regions' and State's pressing water issues.

The method to estimate the available supply, referred to as the *administrative water supply* in the Handbook, is based on withdrawals of water as reported in the *New Mexico Water Use by Categories 2010* report, 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) and thus reflects the amount of water available for use by a region. An estimate of supply during future droughts is also developed by adjusting the 2010 withdrawal data based on physical supplies available during historical droughts, as discussed in Section 5.5.2.

5.5.1 2010 Administrative Water Supply

The administrative water supply (i.e., total withdrawals)) in 2010 for the Lower Pecos Valley region, as reported in the *New Mexico Water Use by Categories 2010* report (Longworth et al., 2013), was nearly 600,000 acre-feet. Of this total, 181,157 acre-feet were surface water withdrawals and 416,123 acre-feet were groundwater. The breakdown of these withdrawals among the various categories of use detailed in the *New Mexico Water Use by Categories 2010* report is discussed in Section 6.1.

5.5.2 Drought Supply

The variability in surface water supply from year to year is a better indicator of how vulnerable a planning region is to drought in any given year or multi-year period than is the use of long-term averages. As discussed in Section 5.1.1, in the Lower Pecos Valley region, 2010 was a year with average or above average precipitation and relatively high snowpack (Figure 5-5) and, according to the PDSI (Figures 5-6a and 5-6b), an above average water year overall. As discussed in Section 5.1, the PDSI is an indicator of whether drought conditions exist and if so, what the relative severity of those conditions is. For the two main climate divisions present in the Lower Pecos Valley region, the PDSI classifications for 2010 were moderately wet (Climate Division 6) and very wet (Division 7). Given that the water use data for 2010 represent a moderately to very wet year, it cannot be assumed that this supply will be available in all years; it is important that the region also consider potential water supplies during drought periods.

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. For purposes of having an estimate of drought supplies for regional and statewide water planning, the State developed and applied a method for regions with both stream-connected and non-stream-connected aquifers. The method adopted for 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 (Table 5-4b) was compared to the 2010 yield, and the gage with the lowest ratio of minimum annual yield to 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.

For the Lower Pecos Valley region, the gage with the minimum ratio of annual yield to 2010 yield is the Pecos River near Malaga, with a ratio of 0.15 for minimum annual yield (9,267 acre-feet in 1977) to 2010 yield (61,320 acre-feet) (USGS, 2014c). Based on the region's total administrative surface water supply of 181,157 acre-feet (Section 5.5.1), the drought-adjusted surface water supply is 27,173 acre-feet. With the 416,123 acre-feet of groundwater supply, the total drought supply is 443,296 acre-feet, or about 74 percent of a normal year administrative water supply.

Though the adjustment is based on the minimum year streamflow recorded to date, it is possible that drought supplies could be even lower in the future. Recharge to aquifers will diminish during drought and reduce the potential yield of aquifers, and that was not factored into the drought supply. Additionally, water supplies downstream of reservoirs may be mitigated by reservoir releases in early drought phases, while longer-term droughts can potentially have greater consequences. This approach also does not evaluate mitigating influences of reservoir storage in early phases of a drought when storage is available, supplemental wells, or potential development of new groundwater supplies. Nonetheless, the adjusted drought supply provides a rough estimate of what may be available during a severe to extreme drought year.

6. Water Demand

To effectively plan for meeting future water resource needs, it is important to understand current use trends as well as future changes that may be anticipated. This section includes a summary of current water use by category (Section 6.1), an evaluation of population and economic trends and projections of future population (Sections 6.2 and 6.3), a discussion of the approach used to incorporate water conservation in projecting future demand (Section 6.4), and projections of future water demand (Section 6.5).

Four terms frequently used when discussing water throughout this plan have specific definitions related to this RWP:

- *Water use* is water withdrawn from a surface or groundwater source for a specific use. In New Mexico water is accounted for as one of the nine categories of use in the *New Mexico Water Use by Categories 2010* report prepared by the NMOSE.
- *Water withdrawal* is water diverted or removed from a surface or groundwater source for use.
- *Administrative water supply* is based on the amount of water withdrawals in 2010 as outlined in the *New Mexico Water Use by Categories 2010* report.
- *Water demand* is the amount of water needed at a specified time.

6.1 Present Uses

The most recent assessment of water use in the region was compiled by NMOSE for 2010, as discussed in Section 5.5. The *New Mexico Water Use by Categories 2010* report (Longworth et al., 2013) provides information on total withdrawals for nine categories of water use:

- Public water supply
- Domestic (self-supplied)
- Irrigated agriculture
- Livestock (self-supplied)
- Commercial (self-supplied)
- Industrial (self-supplied)
- Mining (self-supplied)
- Power (self-supplied)
- Reservoir evaporation

The total surface water and groundwater withdrawals for each category of use, for each county, and for the entire region, are shown on Table 6-1 and Figures 6-1a through 6-1g.

The predominant water use in 2010 in the Lower Pecos Valley region has traditionally been irrigated agriculture; the source is largely groundwater, but Eddy, De Baca and Lincoln counties and the small portion of Otero County in this region rely on surface water. Groundwater comprised 70 percent of total withdrawals in the Lower Pecos Valley Water Planning Region in 2010. Groundwater points of diversion are shown in Figure 6-2.

The categories included in the *New Mexico Water Use by Categories 2010* report and shown on Figure 6-1 and Table 6-1 represent the total withdrawals in the planning region. Tribes and Pueblos in New Mexico are not required to provide water use data to the State; therefore, tribal water use data are not necessarily reflected in this plan. There are also some unquantified additional categories of water use, including riparian evapotranspiration, instream flow, and produced water.

- *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), but riparian evapotranspiration has not been quantified statewide. The New Mexico Water Resources Research Institute is currently developing those estimates but the results are not yet available. 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 the gap reflects the difference between future anticipated demands and present uses, and if both present and future uses do not include the riparian evapotranspiration category, then the difference will not be affected. 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, but anticipated changes have not been quantified and would be subject to considerable uncertainty. Anticipated changes in riparian and stream evapotranspiration are 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 reservoir storage that allows for withdrawals downstream upon release of the stored water. It is recognized that there is also value in preserving instream water for ecosystem, habitat, and tourism purposes. Though this value has not been quantified in the supply/demand gap calculation, it may still be an important use in the region, and if the region chooses, it may recommend instream flow protections in its policy, program, and project recommendations.

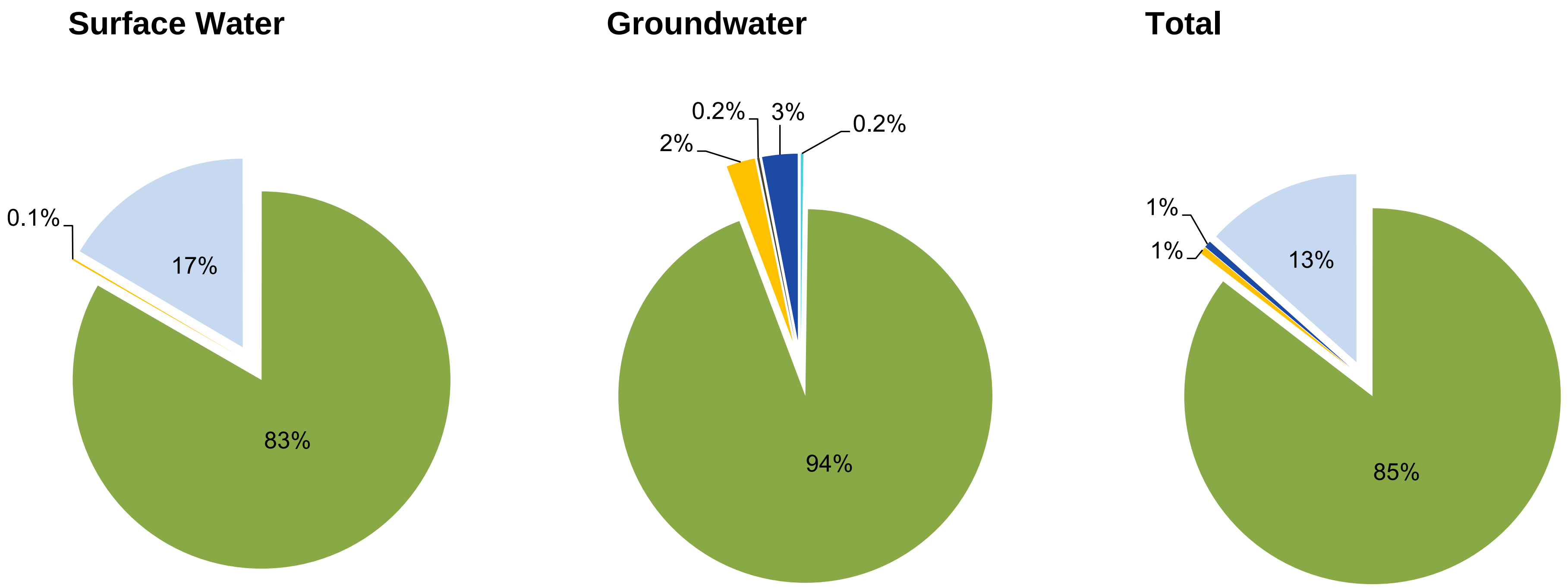
Table 6-1. Total Withdrawals in the Lower Pecos Valley Water Planning Region in 2010

	Withdrawals (acre-feet) [a]																	
	De Baca County			Lincoln County			Chaves County			Otero County			Eddy County			Planning Region		
Water Use Category	Surface Water	Ground-water	Total	Surface Water	Ground-water	Total	Surface Water	Ground-water	Total	Surface Water	Ground-water	Total	Surface Water	Ground-water	Total	Surface Water	Ground-water	Total
Commercial (self-supplied)	0	3	3	0	2,382	2,382	199	2,591	2,789	0	32	32	0	504	504	199	5,511	5,710
Domestic (self-supplied)	0	29	29	0	111	111	0	1,120	1,120	0	159	159	0	203	203	0	1,622	1,622
Industrial (self-supplied)	0	0	0	0	1	1	0	63	63	0	0	0	0	2,109	2,109	0	2,173	2,173
Irrigated agriculture	45,173	12,076	57,249	15,393	4,683	20,076	15,840	225,759	241,598	1,980	0	1,980	78,488	109,738	188,226	156,874	352,256	509,130
Livestock (self-supplied) [b]	78	319	397	145	162	307	231	8,112	8,342	19	22	40	88	1,246	1,335	561	9,861	10,422
Mining (self-supplied)	0	25	25	0	0	0	0	225	225	0	0	0	0	9,303	9,303	0	9,553	9,553
Power (self-supplied)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public water supply	0	392	392	954	2,547	3,501	0	16,559	16,559	72	183	254	0	15,465	15,465	1,025	35,147	36,172
Reservoir evaporation	8,958	0	8,958	0	0	0	0	0	0	0	0	0	13,540	0	13,540	22,498	0	22,498
Total	54,209	12,845	67,054	16,492	9,885	26,377	16,269	254,429	270,698	2,070	395	2,466	92,116	138,568	230,684	181,157	416,123	597,279

Source: Longworth et al., 2013

[a] Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this table.

[b] Livestock use may be higher than reported (Section 6.5.2).



Total usage: 54,209 acre-feet

Total usage: 12,845 acre-feet

Total usage: 67,054 acre-feet

Explanation

- Commercial (self-supplied)
- Industrial (self-supplied)
- Livestock (self-supplied)
- Power (self-supplied)
- Reservoir evaporation
- Domestic (self-supplied)
- Irrigated agriculture
- Mining (self-supplied)
- Public water supply

Source: Longworth et al., 2013

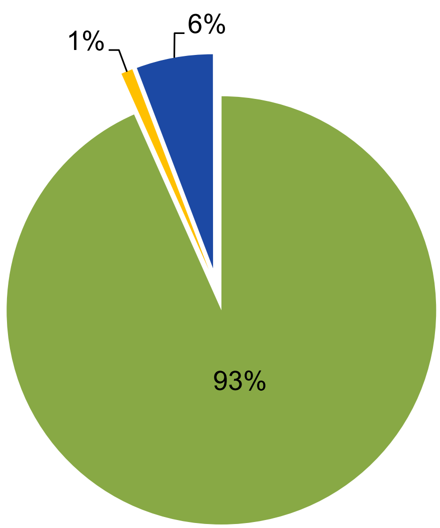
Notes:
1. Only categories with usage above 0.1% are shown.
2. Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

De Baca County Water Demand, 2010

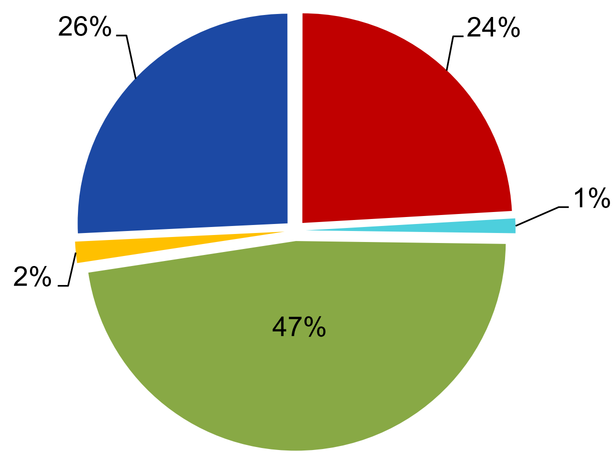
Figure 6-1a

Surface Water



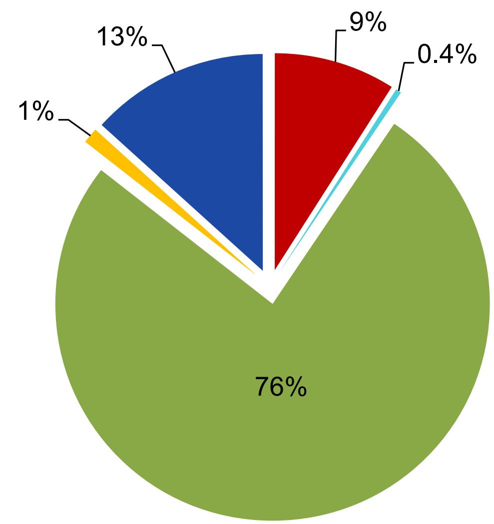
Total usage: 16,492 acre-feet

Groundwater



Total usage: 9,885 acre-feet

Total



Total usage: 9,885 acre-feet

Explanation

- Commercial (self-supplied)
- Industrial (self-supplied)
- Livestock (self-supplied)
- Power (self-supplied)
- Reservoir evaporation
- Domestic (self-supplied)
- Irrigated agriculture
- Mining (self-supplied)
- Public water supply

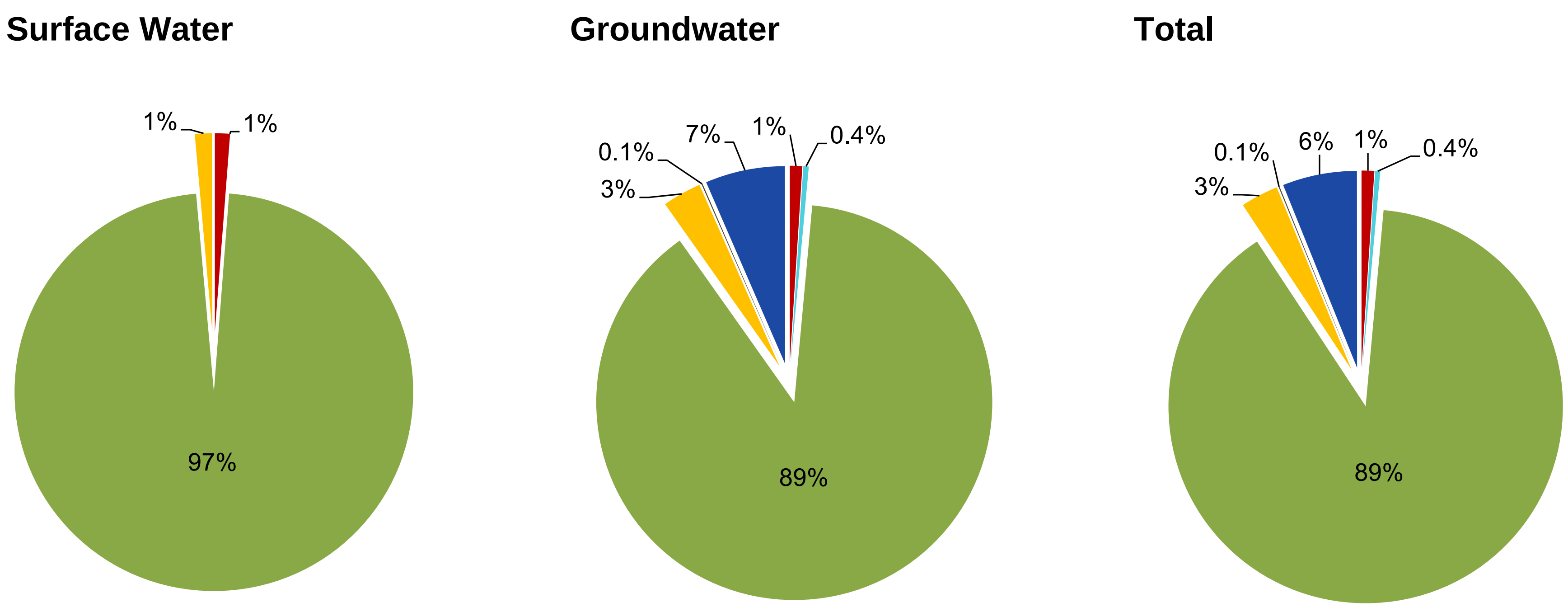
Source: Longworth et al., 2013

Notes:
1. Only categories with usage above 0.1% are shown.
2. Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Lincoln County Water Demand, 2010

Figure 6-1b



Total usage: 16,269 acre-feet

Total usage: 254,429 acre-feet

Total usage: 270,698 acre-feet

Explanation

- Commercial (self-supplied)
- Domestic (self-supplied)
- Industrial (self-supplied)
- Irrigated agriculture
- Livestock (self-supplied)
- Mining (self-supplied)
- Power (self-supplied)
- Public water supply
- Reservoir evaporation

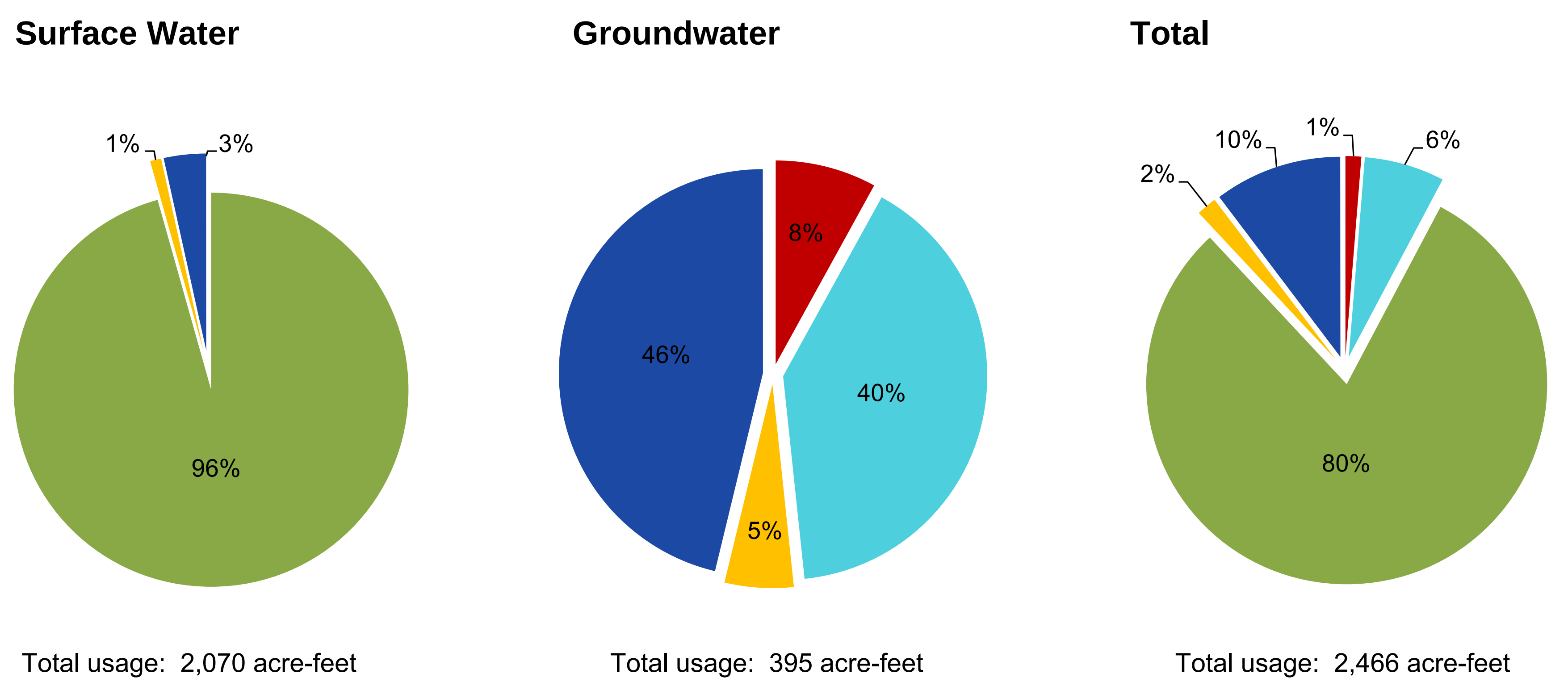
Source: Longworth et al., 2013

Notes:
1. Only categories with usage above 0.1% are shown.
2. Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Chaves County Water Demand, 2010

Figure 6-1c



Explanation

- Commercial (self-supplied)
- Industrial (self-supplied)
- Livestock (self-supplied)
- Power (self-supplied)
- Reservoir evaporation
- Domestic (self-supplied)
- Irrigated agriculture
- Mining (self-supplied)
- Public water supply

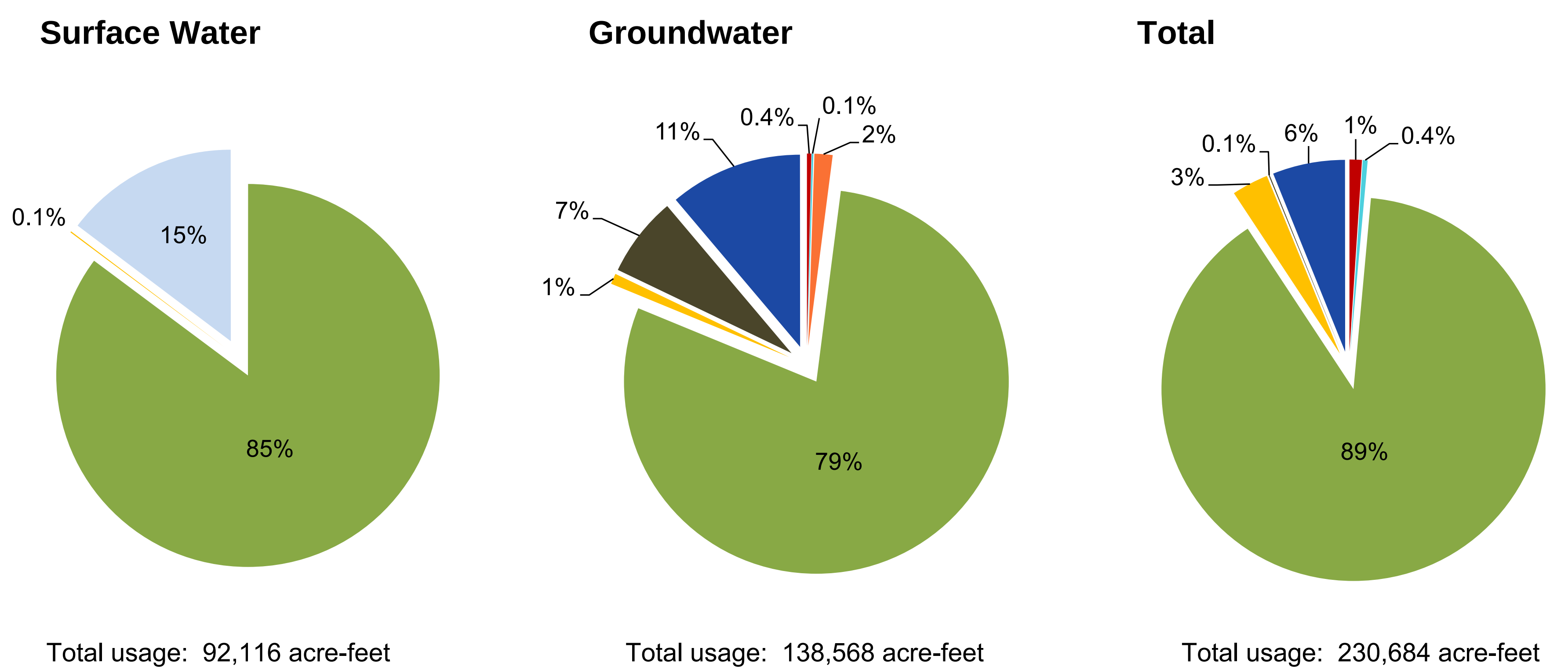
Source: Longworth et al., 2013

Notes:
1. Only categories with usage above 0.1% are shown.
2. Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Otero County Water Demand, 2010

Figure 6-1d



Explanation

- Commercial (self-supplied)
- Domestic (self-supplied)
- Industrial (self-supplied)
- Irrigated agriculture
- Livestock (self-supplied)
- Mining (self-supplied)
- Power (self-supplied)
- Public water supply
- Reservoir evaporation

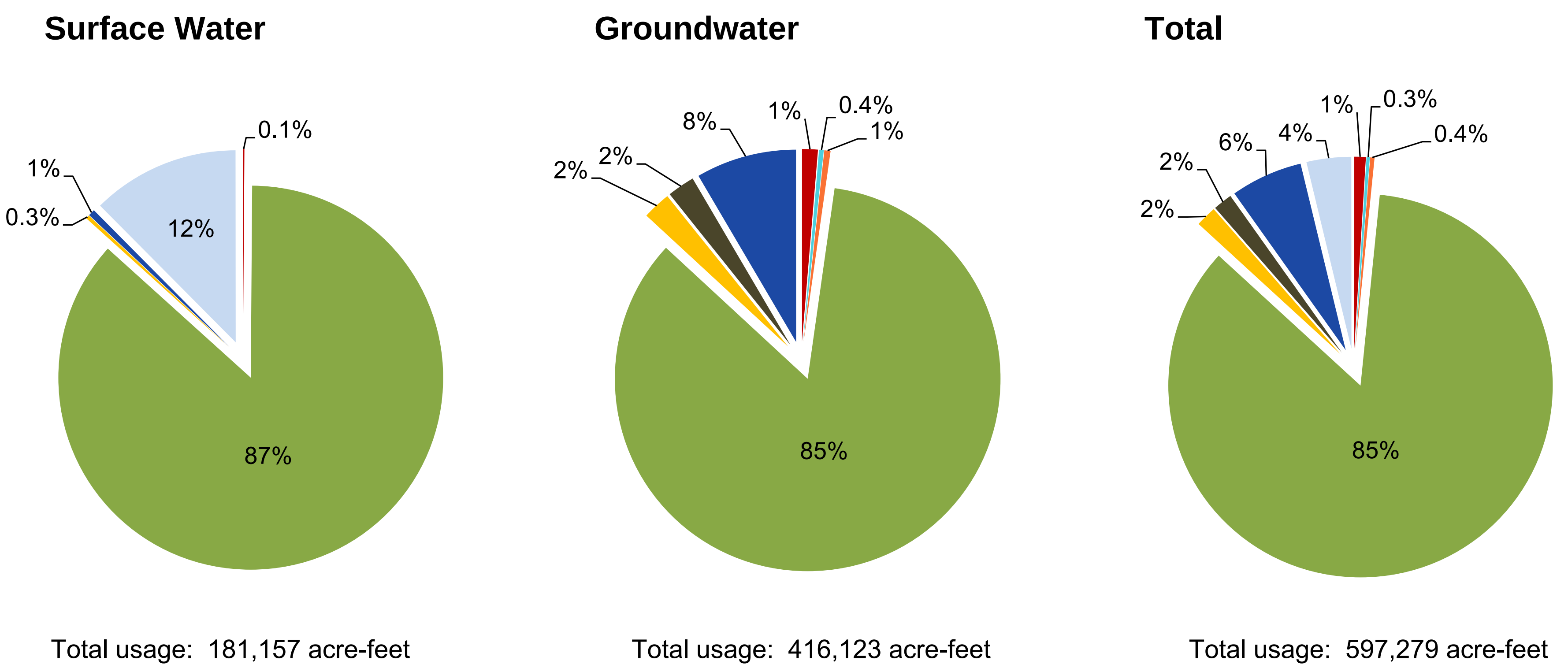
Source: Longworth et al., 2013

Notes:
1. Only categories with usage above 0.1% are shown.
2. Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Eddy County Water Demand, 2010

Figure 6-1e



Explanation

- Commercial (self-supplied)
- Domestic (self-supplied)
- Industrial (self-supplied)
- Irrigated agriculture
- Livestock (self-supplied)
- Mining (self-supplied)
- Power (self-supplied)
- Public water supply
- Reservoir evaporation

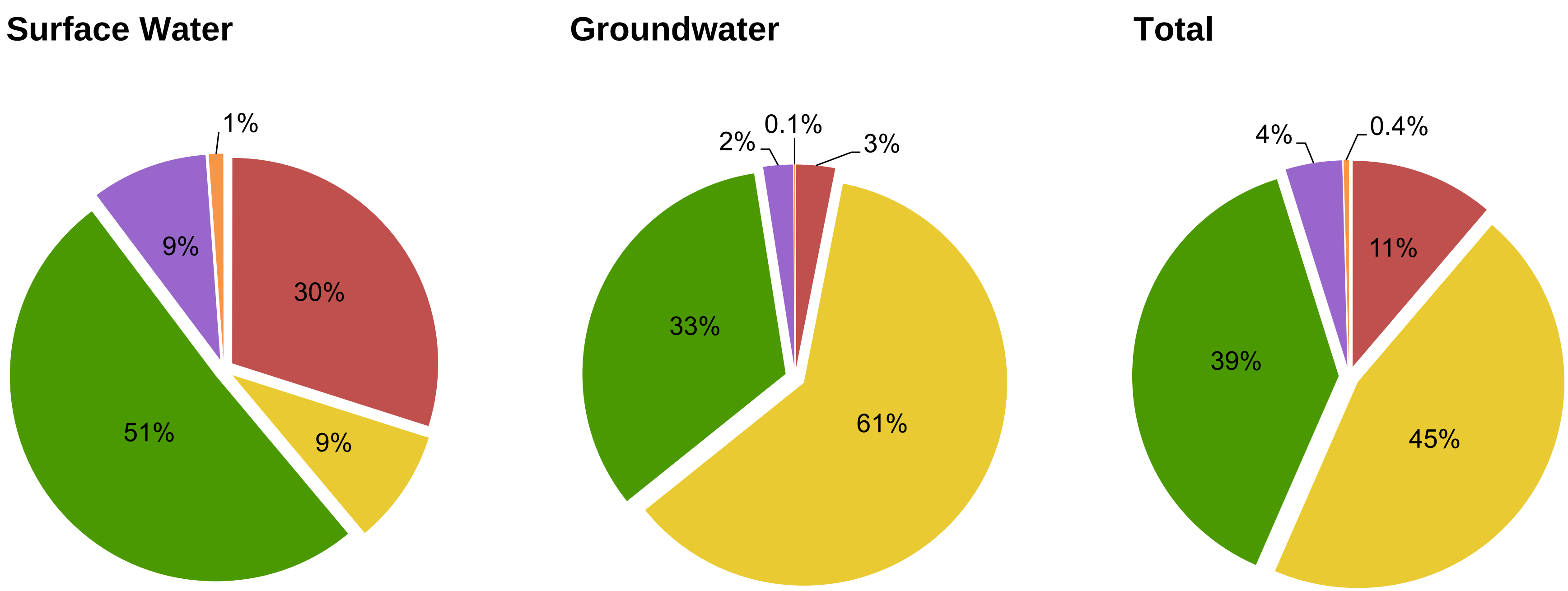
Source: Longworth et al., 2013

Notes:
1. Only categories with usage above 0.1% are shown.
2. Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Total Regional Water Demand by Sector, 2010

Figure 6-1f



Total usage: 181,157 acre-feet

Total usage: 416,123 acre-feet

Total usage: 597,279 acre-feet

Explanation

- De Baca
- Chaves
- Eddy
- Lincoln
- Otero

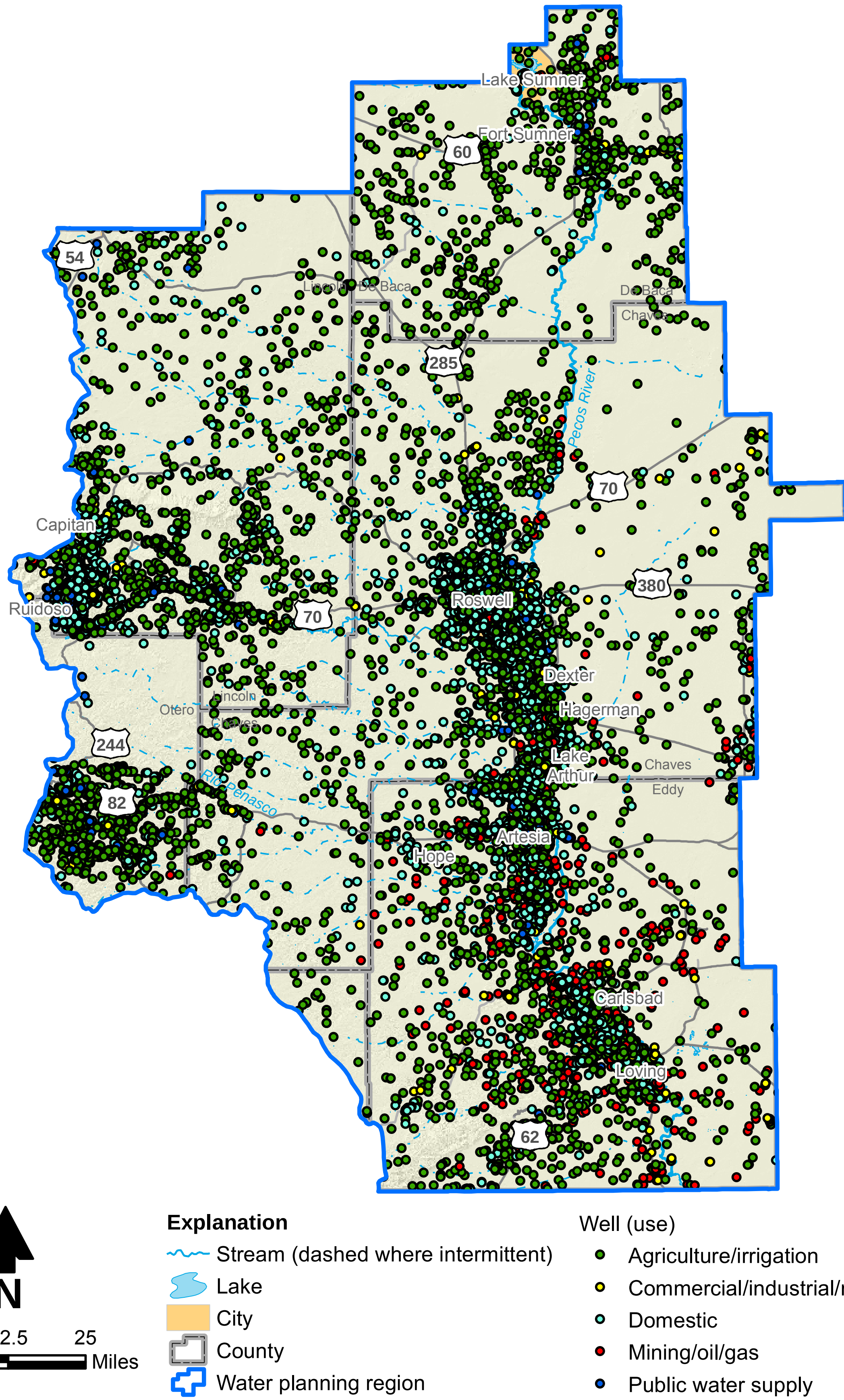
Source: Longworth et al., 2013

Notes:
1. Due to rounding, the percentages may not add to 100%.
2. Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Total Regional Water Demand by County, 2010

Figure 6-1g



LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Groundwater Points of Diversion

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_2016\LOWER_PECOS_VALLEY\FIG6-2_POINTS_OF_DIVERSION.MXD 6/11/2016

Figure 6-2

- *Produced water:* There is significant oil and gas development in the region, and produced water for oil and gas development is not included in the NMOSE water use by categories report (Longworth et al., 2013). Produced water is generally high in total dissolved solids and as part of the oil and gas extraction process, is withdrawn from formations that are deeper than those that supply groundwater. Approximately 8 to 10 barrels of water are produced for every barrel of oil produced (Otton, 2006). The produced water is generally treated and re-injected or discharged to the surface. Since this water is not applied to beneficial use, it is not considered part of the administrative water supply.

In addition to the special conditions listed above, the data provided in the *New Mexico Water Use by Categories 2010* report are available for withdrawals only; depletions have not been quantified. In many cases, some portion of diverted water returns to surface or groundwater, for example from agricultural runoff or seepage or discharge from a wastewater treatment plant. In those locations where there is such return flow, the use of withdrawal data for planning purposes will add a margin of safety; thus the use of withdrawal data is a conservative approach for planning purposes.

6.2 Demographic and Economic Trends

To project future water demands in the region, it is important to first understand demographics, including population growth and economic and land use trends as detailed below. The 2013 populations of De Baca, Lincoln, Chaves, and Eddy counties were 1,907, 20,105, 65,823, and 55,471, respectively (U.S. Census Bureau, 2014a). Only 5 percent of Otero County's population resides within the Lower Pecos Valley region. As shown in Table 3-1a, the population in three of the five counties has either declined since 2010 or held fairly steady. De Baca County, which has no industry, has been steadily losing population since 1940 and suffered a decline of 5.7 percent between 2010 and 2013 (U.S. Census Bureau, 2014a). Lincoln County also lost population while Chaves County, which is heavily reliant on dairies, showed a very small gain. Eddy County, which has benefited from oil drilling, showed healthy growth and will continue to do so as long as the oil boom continues.

As noted in Table 3-1d, beef cattle are the most valuable agricultural commodity in De Baca and Lincoln counties, while milk from dairies is the most valuable in Chaves and Eddy counties. A land use map was included in the accepted water plan, and there have not been substantial changes. In terms of overall agricultural production, Chaves County ranks 1st in agricultural production in New Mexico, while Eddy ranks 6th, Otero 11th, Lincoln 13th, and De Baca 26th.

According to an agricultural economist at New Mexico State University (Hawkes, 2016), the agriculture and livestock sectors are not likely to ever fully recover from the effects of the drought due to several factors. Foremost, the farmers and ranchers are aging, while younger potential replacement farmers often lack the capital to go into the profession. Further, federal and state grazing policies make it difficult to graze cattle on as many leased acres as in the past.

Specific information regarding the population and economic trends in each county is provided in Sections 6.2.1 through 6.2.5. The information provided in these sections was obtained primarily from telephone interviews with government officials and other parties with knowledge of demographic and economic trends in the five counties; the list of interviewees is provided in Appendix 6-A. The information in these following subsections was used to project population, economic growth, and future water demand, as presented in Sections 6.3 and 6.5.

6.2.1 De Baca County

The village of Fort Sumner, with a 2013 population of 975, comprises 51 percent of the total population of De Baca County (U.S. Census Bureau, 2014a). There is only one school in the community, accommodating all grades. A few businesses have closed in the past year, and gross receipts revenues are down.

Despite the fact that 23 percent of the De Baca County population is over 65 years of age, a higher rate than the state average, there is currently no hospital or nursing home in the county. Fort Sumner is building a new senior center for its aging population, but relocation to be closer to specialized healthcare facilities or housed in nursing homes is not uncommon.

De Baca County ranks 6th in the state in alfalfa production and 19th in the number of beef cattle (NMDA, 2015). Pastureland represents 99 percent of the agricultural land in De Baca County (USDA NASS, 2014). Between 2007 and 2012 irrigated acreage declined from 11,460 to 8,070 acres, a decrease of 29.6 percent. The number of farms and ranches increased 17 percent between 2007 and 2012, from 173 to 203, but the average size of farms fell by 15 percent. Livestock sales contributed 63 percent of the market value of products sold in 2012. Government payments to farmers participating in agricultural support programs increased by 173 percent between 2007 and 2012. Due to the drought, some ranchers in the county have sold off their cattle completely, and other ranchers are selling their ranches, mostly to buyers from out of state. However, since the recent drought there has been an increase in livestock numbers and values. For the tax year ending June 30, 2016, there was a one-year increase of 29.6 percent in livestock values due to a 14.0 percent increase in the number of livestock and a 14.3 percent increase in the average value of a cow (Lucero, 2016).

One opportunity for economic development is wind turbines, but that is dependent on construction of transmission lines. Residents have turned down the opportunity to have either a prison or dairies in the community. The largest non-agriculture employment sector is education. The County is working on a comprehensive plan that gives considerable emphasis to economic development.

6.2.2 Lincoln County

The primary economic driver for Lincoln County generally, and the Village of Ruidoso and City of Ruidoso Downs specifically, is tourism. The majority of tourists are from the state of Texas; however, the number of visitors from northern Mexico is growing.

The Village of Ruidoso saw double-digit growth in lodging revenues in 2014 and 2015. The Village's gross receipts are increasing as well. Many homes in the Village of Ruidoso (65 percent) are second homes. Most of the owners of these second homes are from west Texas, but now the area is starting to attract California residents buying vacation homes.

Building activity in Ruidoso is slowly rebounding. Work on a 62-lot residential development is underway. Preliminary plans for two other residential developments are being reviewed. Commercial activity, as well, is improving. Several restaurants have undergone recent expansion. A large venue for special events is near completion. Village voters have approved an $18 million bond for the construction of a new municipal school campus. Construction will begin in 2016 with completion scheduled for 2018. The Village is preparing to initiate a $36 million project to realign wastewater lines.

Commercial activity in the County will benefit from planned construction of a new hospital (expected to be a $30 million project), as well as potential school construction in Capitan.

Retail is seasonal, and there are many vacant storefronts in winter. There has been little new commercial development for several years, but the Village's gross receipts are steady.

There are more houses for sale than there are buyers. Some million dollar second homes turn over occasionally, and some hobby farmers (i.e., persons for whom farming is not their primary source of income) are moving into the County and buying ranches.

The Village of Ruidoso has a water shortage and is under Stage 5 restrictions. Leakage from dams and water lines contributes to the problem, and the Village is trying to remedy the situation, including completing the relining of the Grindstone Dam. The Little Bear fire and flooding in 2012 negatively affected all of Lincoln County, destroying 250 structures and damaging the watershed.

Lincoln County has implemented a subdivision moratorium due to the water shortage. Water rights can no longer be brought in from elsewhere; they have to be on the land. However, because the residential market is flat, there is little demand for new construction. The majority of people who are moving into the County are retired, and about 40 percent of homes in Lincoln County are unoccupied except during the summer.

No residential or commercial development has occurred in Ruidoso Downs (with a 2013 population of 2,690) over the past few years. Some storefronts are vacant, as local businesses could not compete with Walmart, which along with the racetrack is the main generator of gross receipts revenue for Ruidoso Downs. About 15 percent of the homes are second homes for people from out of state.

The percentages of people over 65 in Ruidoso and Lincoln County are 10 percent above the state average. The Ruidoso School District has lost 3 percent of its enrollment. Ruidoso School Superintendent George Bickert attributed the loss to the lack of well-paying jobs in the area.

Cattle herds have declined drastically, by almost 50 percent, over the past few years. Cattle prices are very high due to their limited number but feed prices are also very high. The acreage needed to feed one cow has grown substantially. Ranches that could run 500 to 600 head of cattle now only have 75. Most ranchers are said to now be holding their land only for the tax write-off. However, some are selling, mostly to residents of Texas, and some large ranches are being broken up into smaller parcels. Based on interviews with local residents, many families have been in Lincoln County for five generations and do not want to leave, even though the water situation makes living in the County difficult, and wells routinely run dry.

The average age of an agricultural producer in Lincoln County is 63.5 years. While the number of farms and ranches has not changed, land in farms decreased by 11 percent between 2007 and 2012, and the average size of a farm decreased by 12 percent, from 4,849 acres to 4,291 acres. Despite that, the average total value of products sold increased by 27 percent, from $36,755 to $46,590. Livestock sales accounted for 97 percent of all agricultural sales in the County. Between 2007 and 2012, irrigated acreage declined from 3,746 acres to 1,974 acres, a decrease of 47 percent. Government payments to farmers participating in agricultural support programs in Lincoln County grew by 443 percent and the average payment per farm increased by 125 percent (USDA Census of Agriculture, 2012).

6.2.3 Chaves County

With a 2013 population of 48,611, the city of Roswell comprises 74 percent of the total population of Chaves County. It has shown steady growth. The city is situated on an artesian water supply that has helped the community avoid the more dire effects of the drought that other communities have suffered.

The tourism, dairy farm, agriculture, and industrial sectors are central to Roswell's economy. The city is home to the International UFO Museum and Research Center and the Roswell Industrial Air Center, a city-owned public-use airport. Besides being a municipal airport with commercial flights to Dallas as well as general aviation flights, the Air Center also accommodates military flights. In addition to the airport, the Air Center hosts aircraft repair and refurbishing companies, a plastics manufacturer, a bus factory, and an Eastern New Mexico

University campus. In September 2014 AerSale, an international supplier of aftermarket aircraft, announced it will increase operations at the Air Center, adding 50 new jobs to its existing 100.

The Air Center offers a tax incentive to businesses that locate there. A larger hangar will be available in five years, and the Air Center will be a destination for maintenance and repair of large aircraft.

Roswell is also home to a large mozzarella cheese plant operated by Leprino Foods, headquartered in Denver. Local dairies supply the milk. Both ranches and dairies have been negatively affected by the drought, and the dairies have also been affected by low milk prices and the fact that since 2008 banks have required them to collateralize their loans. The County has lost four dairies in the past few years, mostly due to foreclosures, although one was closed due to the exposure by a non-profit organization of animal cruelty at the facility (Kolb, 2014). The County now has about 33 dairies (the most in New Mexico), the most milk cows, and the highest milk production (NMSU Dairy Extension, 2014).

Feed crops are doing well because of high prices for hay and silage. However, cattle herds have been culled due to the high feed prices. There is also a shortage of young cattle to replenish herds. Kohler said his bank has money to lend, but nobody to lend to. Agricultural producers are not seeking loans because of the vulnerability of the agriculture sector and stricter loan requirements that demand more collateral.

Nevertheless, the number of agricultural producers in Chaves County remained stable between 2007 and 2012, as did the number of acres. The value of products sold increased by 14 percent in the time period. However, between 2007 and 2012, irrigated acreage declined from 63,053 to 49,756 acres, a decrease of 21.1 percent. Livestock sales contributed 88 percent of agricultural revenues, totaling $343.0 million in 2012. Government payments to farmers participating in agricultural support programs rose 138 percent between 2007 and 2012 to $4.7 million. Chaves County has a large number of farms and ranches with more than 1,000 acres (USDA NASS, 2012). A few very large ranches have sold over the past year.

The economy of Chaves County is improving; gross receipts are up by about 5 percent from 2013 to 2014, the first time they have risen since 2009. Commercial growth is steady, and the City is trying to develop its old Railroad District.

New residential construction is occurring, and new subdivisions are being planned. Many residents live in Roswell and commute to jobs in the City of Artesia and elsewhere in Eddy and Lea counties. Housing in Roswell is less expensive than in Artesia, which is home to a Federal Law Enforcement Training Center. Residential development has been increasing 3 percent per year for the past few years, and commuters are driving this growth. An overabundance of platted lots left over from the Air Force Base works against development in Roswell. However, a new 320-unit multi-family residential development is being built in Roswell and will accommodate the oil field workers in Carlsbad and Hobbs who live in Roswell because of the housing shortage in those cities.

Roswell is home to many chain retailers such as Target (the only one in a 200-mile radius), Walmart, and Sam's Club. City officials believe that the area could support a much larger population and economic activity because it is located on a replenishing aquifer. Several new businesses are moving in and others are inquiring. One problem is the difficulty in finding qualified applicants, and many jobs in Chaves County are going unfilled because of lack of qualified personnel. The hospital is struggling to fill its jobs, and skilled jobs at the Air Center, such as aircraft painting, are also going unfilled. There has been an influx of fast food restaurants in Roswell and they also struggle to hire employees.

6.2.4 Otero County

The section of Otero County in the Lower Pecos Valley Water Region is rural and is mainly composed of the Lincoln National Forest and the Mescalero Apache Reservation. The Mescalero Reservation land straddles the watershed divide, and thus the regional water planning boundary, and the tribe participated in both the Lower Pecos Valley regional planning and Tularosa-Salt Basin planning processes. The Mescalero tribe operates the Inn of the Mountain Gods and Casino Apache, which are both large tourist attractions in the Ruidoso area. The population is composed of cattle farmers and ranchers.

6.2.5 Eddy County

Eddy County was one of the few counties in the state to show substantial population growth between 2010 and 2013, increasing by 3.1 percent. Carlsbad, the largest city, grew even faster, at 5.8 percent, and with its 27,653 residents, comprises 50 percent of the population in the county. Artesia, the second largest city, had a slower growth rate and reached 11,484 persons in 2013 (U.S. Census Bureau, 2013). Eddy County had a per capita income 14 percent higher than the state average from 2008 to 2012 and a poverty rate 6.5 percent below the state average (U.S. Census Bureau, 2014c).

Mining is the largest basic industry (one that exports goods and services outside of Eddy County) and includes potash, oil, natural gas extraction, and gravel. The largest drillers are Halliburton, Occidental, Devon Energy, and Superior Energy, and more than 2,000 applications for drilling permits have been filed. The estimate for the number of wells that could be drilled ranges from 3,000 to 5,000. Yates Petroleum is a New Mexico-based company that has been headquartered in Artesia since 1924 and employs over 300 staff at that location. Yates was purchased by EOG Resources in October 2016; EOG intends to keep the Artesia office fully staffed and to expand drilling in the area (Treflis Team, 2016; Bryan, 2016).

Eddy County is home to two large potash producers: the Mosaic Company and Intrepid Potash. In July 2014, fertilizer producer Mosaic said that it would permanently halt production of muriate of potash at its Carlsbad mine due to the quality of ore and age of the facility. However, Mosaic stated that it plans to continue producing a premium potash product at Carlsbad, called K-Mag (Reuters, 2014). The company's plan calls for a processing plant and would involve the drilling of water wells, installation of pipelines, and storage of tailings.

In August 2014, Intercontinental Potash announced that it had found foreign investors for a potash mine east of Carlsbad that is estimated to cost $1.02 billion. Named the Ochoa Project, the operation could create 400 new jobs in the area, and if funding is secured, the project could start in 2015 (Ponce, 2014).

An industrial park that was empty for 25 years is now full. Many of the uses within the park are water intensive, and one tenant, Halliburton, is using brackish water. The Intrepid potash mine, a large water user, is also permitted to use brackish water.

The County temporarily lost 140 jobs in February 2014 when the Waste Isolation Pilot Plant closed down because of a radiation leak. No firm date has been set for reopening.

The Carlsbad area caters to tourists, as it is close to Carlsbad Caverns National Park, but tourism is being affected by the growth of the oil and gas industry, which has created a housing shortage. Rates for motel rooms have skyrocketed (the least expensive motel room is $150 per night), and often no rooms are available because the oil companies are renting rooms on a monthly basis. As a result, more tourists are making day trips and fewer are staying overnight. This has negatively affected some restaurants and shops.

The City of Carlsbad is enjoying a construction boom with $33 million in permitted construction in the works. Four hotels began construction in 2014, and three more are in the permitting phase. As demand is so much greater than supply, it is likely that more motels will be built. New restaurants and theaters are under construction.

Carlsbad recently annexed 1,300 acres for residential development that will occur over the next 10 years. New residential construction includes single-family homes, but mainly multi-family rental projects to provide housing for oil workers who are in the area temporarily. Eddy County has a large transient workforce, and many oil workers live in mobile homes or travel trailers in makeshift camps.

Texas construction companies are doing most of the building in Eddy County, and Texas banks are handling the financing, especially for the larger apartment projects. Although out-of-state lenders are active in the area, there is believed to be enough business for all banks. Local lending has kept up with demand, and commercial lending has been especially robust.

Land values have increased at a rate well above historical levels, with industrial land escalating 600 percent. Between 2013 and 2014, the residential market values increased by 7 percent. There is concern that retirees, who comprise a large percentage of Eddy County's population, will be priced out of the market within ten years. Two nursing homes and an assisted living facility have been built in Carlsbad recently.

While the City of Carlsbad is growing in population, water consumption is flat because the city implemented a voluntary water conservation program in 2011 that has achieved good compliance. A new water pipeline is currently being constructed, and Phases 1 and 2 should be completed in 2015. The pipeline will have 27 miles of 24-inch pipe and cost $45 million. Included in a planned Phase 3 is a new reservoir with a chlorination facility.

While Carlsbad has a healthy economy, employers are having difficulty attracting skilled workers. Jobs that pay the minimum wage elsewhere pay between $9 (fast food restaurants) and $15 (retail stores) in Carlsbad. The city has added 46 new positions, growing its workforce by 10 percent. Carlsbad is believed to have the highest paid law enforcement officers and teachers in New Mexico. The community is having difficulty attracting doctors (the hospital has 46 open positions), lawyers, and dentists because the area is so rural. Reasons include lack of housing, but also the fact that the New Mexico income tax compares unfavorably with neighboring Texas, which does not have one.

Reportedly, 900 open jobs are available within a 45-minute radius of Carlsbad. One-quarter of the openings are for professional jobs, such as engineers and managers; however, the oil companies still manage the drilling from their Texas offices. Truck drivers for oil tankers are much in demand, and these jobs pay about $60,000.

The city of Artesia has a diversified economy, with both the oil and gas industry and the federal government offering employment. Artesia is the headquarters for Yates Petroleum (now EOG Resources) and is also home to the Navajo Refinery, operated by the Holly Frontier Corporation which has a capacity of 100,000 barrels per day. The Federal Law Enforcement Training Center (FLETC), which employs 900 people, hosts the country's Border Patrol Academy that trains all Border Patrol agents. In July 2014 the facility was designated as temporary housing for women and children who had entered the United States illegally. School enrollment is the largest in the City's history, with 200 students added in the past year, and the community may need to build another school.

There are 750 unfilled jobs in Artesia. A major impediment to attracting workers is the shortage and high prices of housing. Between 800 and 1,200 people commute daily to Artesia from Roswell and Carlsbad. Although 335 apartment units have just been added to the supply, this will not alleviate the housing problem. New phases are being planned. The Chamber is trying to entice hotels, apartment developers, and assisted living developers to Artesia.

The community's biggest problems are lack of housing and insufficient water rights. Navajo Refinery, with 470 employees, is the City's largest private sector employer and would like to expand, but it needs more water to do so.

According to the NMSU Dairy Extension, there were three dairies in Eddy County in 2011 (NMSU Dairy Extension, 2014); the USDA Census of Agriculture counted 13 in 2012 (USDA NASS, 2014), but the number of cows differed by only 1,000. Between 2007 and 2012 irrigated acreage decreased by 18.3 percent, from 52,974 acres to 43,254 acres, and the number of farms increased by 1 percent. The market value of products sold increased by 26 percent to $119.6 million, of which 58 percent, or 69.1 million, were livestock sales. Government payments to farmers participating in agricultural support programs increased 46 percent to $2.5 million (USDA Census of Agriculture, 2012).

6.3 Projected Population Growth

The Bureau of Business and Economic Research (BBER) at the University of New Mexico (UNM) prepared county-level population forecasts through 2060 for the 2001 regional water plan (PVWUO, 2001), using data and historical trends from 1960 through the 2000 Census. The 2001 plan did not account for the oil boom now affecting Eddy County, or for Roswell becoming a bedroom community for Eddy and Lea counties, so the projections for 2010 for Eddy were too low, as were those for Lincoln County (Table 6-2). Conversely, the De Baca and Otero counties projections were too optimistic. The forecast for Chaves County was very close to the actual population in 2010.

Table 6-2 Comparison of Projected and Actual 2010 Population

County	2001 Regional Water Plan Projected Population [a]	Actual Population 2010 U.S. Census [b]
DeBaca	2,396	2,022
Lincoln	16,139	18,941
Chaves	65,824	65,614
Otero	3,899	3,372
Eddy	61,216	53,816
Total Region	149,474	143,765

[a] Pecos Valley Water Users Organization, 2001
[b] U.S. Census Bureau, 2014a

For the current population projections through 2060 (Table 6-3), two population forecasts were developed: one based on a moderately optimistic view of the economy for this region over the long-term and one that portrays a more pessimistic picture. The 2012 BBER population projections through 2040 (Appendix 6-B) were used as a starting point for the low/high population projections, extrapolated through 2060. The population projections are detailed in Table 6-3 and summarized by county below:

Table 6–3. Lower Pecos Valley Population Projections July 1, 2010 to July 1, 2060

a. Annual Growth Rate

County	Projection	Growth Rate (%)				
		2010-2020	2020-2030	2030-2040	2040-2050	2050-2060
DeBaca	High	–1.16	–1.08	–1.24	–1.11	–0.86
	Low	–1.89	–1.89	–1.68	–1.61	–1.57
Lincoln	High	0.11	0.54	0.14	–0.02	–0.02
	Low	–0.25	0.03	0.06	–0.05	–0.16
Chaves	High	0.58	0.68	0.99	0.65	0.47
	Low	0.20	0.37	0.42	0.36	0.52
Otero	High	0.08	0.06	0.11	0.11	0.03
	Low	–0.05	–0.04	–0.08	–0.06	–0.02
Eddy	High	0.92	1.44	1.18	0.88	0.77
	Low	0.73	0.93	0.65	0.59	0.53

b. Projected Population

County	Projection	Population					
		2010	2020	2030	2040	2050	2060
DeBaca	High	2,022	1,800	1,615	1,425	1,275	1,170
	Low	2,022	1,670	1,380	1,165	990	845
Lincoln	High	18,941	19,155	20,205	20,480	20,445	20,410
	Low	18,941	18,480	18,535	18,644	18,550	18,255
Chaves	High	65,614	69,525	74,435	82,175	87,650	91,850
	Low	65,614	66,915	69,410	72,411	75,080	79,100
Otero	High	3,372	3,400	3,422	3,460	3,498	3,510
	Low	3,372	3,354	3,340	3,315	3,295	3,288
Eddy	High	53,816	58,965	68,044	76,545	83,560	90,225
	Low	53,816	57,900	63,540	67,800	71,930	75,840

Source: Poster Enterprises, 2014

- De Baca County: The population of De Baca County has been declining since 1940 and is projected to continue to do so in both the high and low scenarios. (There has been recent growth in the unincorporated area of the county, according to the De Baca County Draft Comprehensive Plan [ARC, 2016].) The County has a percentage of people over 65 years of age higher than the state average, and the population is declining faster than the 2012 BBER forecast (Appendix 6-B) anticipated. Therefore, both the high and low projections are lower than the BBER projection.

- Chaves County: The population is projected to grow under both the high and low scenarios. While the BBER projected high growth between 2010 and 2025, the projections developed for this RWP update show modest growth between now and 2020 and more growth after 2030. Throughout the remainder of the projection period, the high projection is slightly lower than the 2012 BBER projection, and the low projection anticipates that Eddy County and Lea County will eventually build enough housing to meet demand, so that fewer people will find it necessary to commute from Roswell.

- Eddy County: The Eddy County high projection developed for this RWP update tracks with the BBER numbers through 2020, but whereas the BBER projects growth rates after 2020 to decline, the projections for this RWP update show increasing growth, predicated on a healthy oil and gas industry and more housing being built. The low projection shows more modest growth and contemplates a possible decline in the oil and gas industry, which is subject to fluctuating prices. Nevertheless, the low projections presented here are modestly more optimistic than the BBER's numbers.

- Lincoln County: Whereas the BBER numbers show a decline in population starting after 2030, the projections for this RWP update do not show a decline until after 2040. The high projections generally track with the BBER's, taking into account that the BBER numbers are for the entire county while the ones presented here are only for the portion in the Lower Pecos Water Planning Region. The low scenario anticipates a continuing struggle with water supply that would affect tourism.

- Otero County: The projections for this small portion of the County show limited growth under the high scenario and a slow decline under the low.

6.4 Water Conservation

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 NMOSE developed the *New Mexico Water Conservation Planning Guide for Public Water Suppliers*. When evaluating water rights transfers or 40-year water development plans that hold water rights for future use, the NMOSE considers whether adequate conservation measures are in place. However, the 40-year water development plans are not incorporated into the RWP updates, as the resources needed to complete this work are not currently available. It is therefore important when planning for meeting future water demand to consider the potential for conservation.

To develop demand projections for the region, some simplifying assumptions regarding conservation have been made. These assumptions were made only for the purpose of 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. Specific recommendations for conservation programs and policies for the Lower Pecos Valley region, as identified by the regional steering committee, are provided in Section 8.

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 NMOSE developed a GPCD (gallons per capita per day) calculation 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 the region, shown in Table 6-4. These rates are provided to assist the regional steering committee 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 the region), excluding those served by domestic wells. For future projections (Section 6.5), a consistent method is being used statewide that 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.

Table 6-4. 2010 Water Withdrawals for Drinking Water Supply Systems and Rural Self-Supplied Homes
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OSE Declared Groundwater Basin(s) [a]	Water Supplier [b]	Population	Per Capita Use (gpcd)	Withdrawals (acre-feet)	
				Surface Water	Groundwater
De Baca County					
Fort Sumner	Fort Sumner Municipal Water System	1,216	214	0	291
	Valley WUA	480	188	0	101
	De Baca County public water supply totals	1,696		0	392
	County-wide public water supply per capita use [c]		207		
Fort Sumner Roswell	Rural self-supplied homes (Pecos)	326	80	0	29
	De Baca County domestic self-supplied totals	326		0	29
	County-wide domestic self-supplied per capita use [c]		80		
Lincoln County					
Hondo	Alpine Village Sanitation District	112	63	0	8
	Alto Alps Homeowners Association	219	44	0	11
	Alto Lakes Water Co-op	1,418	78	0	124
	Alto North Water Co-op	93	96	0	10
	Apple Blossom & White Angel Mesa	23	133	0	3
	Capitan Water System	1,385	129	0	200
	Fawn Ridge Homeowners Association	140	47	0	7
	Ft Stanton Medical Center [d]	233	317	0	83
	High Sierra Estates	74	74	0	6
	Lincoln MDWCA	70	187	0	15
	Ruidoso Downs Water System	2,618	170	0	497

Source: Longworth et al., 2013, unless otherwise noted.

[a] Determined based on NMED Drinking Water Bureau water supply source locations (NMOSE water use database doesn't distinguish groundwater basin).
[b] For systems supplied by surface water withdrawals, the river basin is provided in parentheses. Rural self-supplied homes are located in the river basin specified in parentheses.
[c] County-wide per capita use, calculated as the total population divided by total withdrawals.
[d] Groundwater basin assumed based on geographic location of water supplier.

gpcd = Gallons per capita per day

Table 6-4 2010 Water Withdrawals for Drinking Water Supply Systems and Rural Self-Supplied Homes

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OSE Declared Groundwater Basin(s) [a]	Water Supplier [b]	Population	Per Capita Use (gpcd)	Withdrawals (acre-feet)	
				Surface Water	Groundwater
Lincoln County (cont.)					
Hondo (cont.)	Ruidoso Water System (Pecos)	9,300	214	932	1,302
	Sun Valley Sanitation District	353	45	0	18
	The Riverbend	70	70	0	5
NA	Agua Fria Water Company (Pecos)	186	105	22	0
	Rancho Ruidoso Village	186	360	0	196
	Rocky Mountain Mobile Home & RV Park	84	23	0	2
Roswell	Corona Water System	209	254	0	59
	Lincoln County public water supply totals	16,772		954	2,547
	County-wide public water supply per capita use [c]		186		
Hondo Roswell	Rural self-supplied homes (Pecos)	1,236	80	0	111
	Lincoln County domestic self-supplied totals	1,236		0	111
	County-wide domestic self-supplied per capita use [c]		80		
Chaves County					
NA	Country Acres Mobile Home Park	35	69	0	3
Roswell	Berrendo WUA	3,220	478	0	1,723
	Cumberland WUA	475	215	0	115
	Dexter Municipal Water System	1,500	608	0	1,021
	Fambrough Water Co-op	466	214	0	111
	Greenfield MDWCA	300	186	0	62

Source: Longworth et al., 2013, unless otherwise noted.

[a] Determined based on NMED Drinking Water Bureau water supply source locations (NMOSE water use database doesn't distinguish groundwater basin).

[b] For systems supplied by surface water withdrawals, the river basin is provided in parentheses. Rural self-supplied homes are located in the river basin specified in parentheses.

[c] County-wide per capita use, calculated as the total population divided by total withdrawals.

[d] Groundwater basin assumed based on geographic location of water supplier.

gpcd = Gallons per capita per day
NA = Information not available

Table 6-4 2010 Water Withdrawals for Drinking Water Supply Systems and Rural Self-Supplied Homes

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OSE Declared Groundwater Basin(s) [a]	Water Supplier [b]	Population	Per Capita Use (gpcd)	Withdrawals (acre-feet)	
				Surface Water	Groundwater
Chaves County (cont.)					
Roswell (cont.)	Hagerman Water System	1,200	181	0	244
	Lake Arthur Water Co-op	370	289	0	120
	Roswell Municipal Water System	48,000	242	0	12,999
	South Springs Acres [d]	80	1,796	0	161
	Chaves County public water supply totals	55,646		0	16,559
	County-wide public water supply per capita use [c]		266		
Fort Sumner Penasco Roswell	Rural self-supplied homes (Pecos)	9,999	100	0	1,120
	Chaves County domestic self-supplied totals	9,999		0	1,120
	County-wide domestic self-supplied per capita use [c]		100		
Otero County					
Penasco	Cloud Country Estates WUA (Pecos)	70	836	49	17
	Cloud Country West Water System	200	71	0	16
	Mayhill Water Supply Company	80	52	0	5
	Pete Ragan Memorial WUA	42	100	0	5
	Pinon WUA	100	213	0	24
	Ponderosa Pines Property Owners Association	100	93	0	10
	Robinhood Park WUA	208	150	0	35
	Silver Cloud WUA	100	119	0	13

Source: Longworth et al., 2013, unless otherwise noted.

[a] Determined based on NMED Drinking Water Bureau water supply source locations (NMOSE water use database doesn't distinguish groundwater basin).

[b] For systems supplied by surface water withdrawals, the river basin is provided in parentheses. Rural self-supplied homes are located in the river basin specified in parentheses.

[c] County-wide per capita use, calculated as the total population divided by total withdrawals.

[d] Groundwater basin assumed based on geographic location of water supplier.

gpcd = Gallons per capita per day
NA = Information not available

Table 6-4. 2010 Water Withdrawals for Drinking Water Supply Systems and Rural Self-Supplied Homes
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OSE Declared Groundwater Basin(s) [a]	Water Supplier [b]	Population	Per Capita Use (gpcd)	Withdrawals (acre-feet)	
				Surface Water	Groundwater
Otero County (cont.)					
Penasco (cont.)	Twin Forks MDWCA (Pecos)	1,090	64	23	55
	Weed WUA	25	97	0	3
	Otero County public water supply totals	2,015		72	183
	County-wide public water supply per capita use [c]		113		
Hondo Penasco	Rural self-supplied homes (Pecos)	1,423	100	0	159
	Otero County domestic self-supplied totals	1,423		0	159
	County-wide domestic self-supplied per capita use [c]		100		
Eddy County					
Carlsbad	Happy Valley Water Co-op	615	126	0	87
	Loving Water System	1,700	91	0	173
	Malaga Water Users Co-op	780	182	0	159
	Otis Water Co-op	5,155	134	0	771
	Westwind Mobile Home Park	165	131	0	24
	White's City	40	841	0	38
Carlsbad Lea County	Carlsbad Municipal Water System	27,000	274	0	8,299
NA	Jewel St. Water Co-op	22	112	0	3
Roswell	Artesia Domestic Water System	11,304	393	0	4,981
	Artesia Rural Water Co-op	2,695	143	0	433
	Caprock Water Company	47	1,731	0	91
	Cottonwood Water Cooperative	1,245	135	0	189

Source: Longworth et al., 2013, unless otherwise noted.

[a] Determined based on NMED Drinking Water Bureau water supply source locations (NMOSE water use database doesn't distinguish groundwater basin).
[b] For systems supplied by surface water withdrawals, the river basin is provided in parentheses. Rural self-supplied homes are located in the river basin specified in parentheses.
[c] County-wide per capita use, calculated as the total population divided by total withdrawals.

gpcd = Gallons per capita per day
NA = Information not available

Table 6-4 2010 Water Withdrawals for Drinking Water Supply Systems and Rural Self-Supplied Homes

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OSE Declared Groundwater Basin(s) [a]	Water Supplier [b]	Population	Per Capita Use (gpcd)	Withdrawals (acre-feet)	
				Surface Water	Groundwater
Eddy County (cont.)					
Roswell (cont.)	Hope Water System	102	333	0	38
	Morningside Water Cooperative	500	189	0	106
	North Park MDWCA	250	160	0	45
	Riverside WUA	400	67	0	30
	Eddy County public water supply totals	52,020		0	15,465
	County-wide public water supply per capita use [c]		266		
Capitan Carlsbad Lea County Roswell	Rural self-supplied homes (Pecos)		100	0	203
	Eddy County domestic self-supplied totals	1,809		0	203
	County-wide domestic self-supplied per capita use [c]		100		

Source: Longworth et al., 2013, unless otherwise noted.

[a] Determined based on NMED Drinking Water Bureau water supply source locations (NMOSE water use database doesn't distinguish groundwater basin).

[b] For systems supplied by surface water withdrawals, the river basin is provided in parentheses. Rural self-supplied homes are located in the river basin specified in parentheses.

[c] County-wide per capita use, calculated as the total population divided by total withdrawals.

gpcd = Gallons per capita per day

For the Lower Pecos Valley region, current per capita use in Otero County is under 130 gpcd (Table 6-4), so no additional conservation is assumed. Lincoln County currently has per capita use between 130 and 200 gpcd (Table 6-4), so their future per capita demand is assumed to be reduced to 130 gpcd. De Baca, Chaves, and Eddy counties currently have per capita use between 200 and 300 gpcd (Table 6-4), so their future per capita use is assumed to be reduced to 150 gpcd. In the projections, these reductions are phased in over time.

Self-supplied domestic. Homeowners with private wells can achieve water savings through household conservation measures. These wells are not metered, and current water use estimates were developed based on a relatively low per capita use assumption (Table 6-4; 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 region, conservation in this sector may be 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 as a result 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). Application of such technologies has been significant in recent decades, especially in the Roswell area. These efforts can result in economic benefits, such as increased crop yield, but may have the adverse effect of reducing return flows and therefore downstream water supply. For example, methods such as canal lining or piping may result in 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, 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 are 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. Section 8 outlines strategies developed by the Lower Pecos Valley steering committee to achieve savings in agricultural water use within the region.

Self-supplied commercial, industrial, livestock, mining, and power. Conservation programs can be applicable to these sectors, but since uses are very low in these categories within the region, no additional conservation savings are assumed in the water demand projections.

Reservoir evaporation. In many parts of New Mexico, reservoir evaporation is one of the highest consumptive water uses, and in the Lower Pecos Valley region it is the third highest water use. To reduce usage in this category, some areas outside of the region have considered aquifer 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. However, due to the legal, financial, and other complexities of implementing these techniques, no conservation savings are assumed in developing the reservoir evaporation demand projections for this region.

6.5 Projections of Future Water Demand for the Planning Horizon

To develop projections of future water demand a consistent method was used statewide. Section 6.5.1 provides a comprehensive discussion of the methods applied consistently throughout the state to project water demand in all the categories reported in the *New Mexico Water Use by Categories* reports, and some of the categories may not be applicable to the Lower Pecos Valley region. The projections of future water demand determined using this consistent method, as applicable, for the Lower Pecos Valley region are discussed in Section 6.5.2.

6.5.1 Water Demand Projection Methods

The *Handbook* provides the time frame for the projections; that is, they should begin with 2010 data and be developed in 10-year increments (2020, 2030, 2040, 2050, and 2060). Projections will be for withdrawals in each of the nine categories included in the *New Mexico Water Use by Categories 2010* report (Longworth et al., 2013) and listed in Section 6.1.

To assist in bracketing the uncertainty of the projections, low and high water demand estimates were developed for each category in which growth is anticipated, based on demographic and economic trends (Section 6.2) and population projections (Section 6.3), unless otherwise noted. The projected growth in population and economic trends will affect water demand in eight of the nine water use categories; the reservoir evaporation water use category is not driven by these factors.

The 2010 administrative water supply (Section 5.5.1) was used as a base supply from which water demand was projected forward. As discussed in Section 5.5, the administrative water supply is based on withdrawals of water as reported in the *New Mexico Water Use by Categories 2010* report, which provide a measure of supply that considers both physical supply and legal restrictions (i.e., the water is physically available for withdrawal, and its use is in compliance with water rights policies) and thus reflects the amount of water available for use by a region..

The assumptions and methods used statewide to develop the demand projections for each water use category follow. Not all of these categories are applicable to every planning region. The specific methods applied in the Lower Pecos Valley region are discussed in Section 6.5.2.

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 above), times 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 the high and low projections incorporated conservation for counties with per capita use above 130 gpcd, as discussed in Section 6.4, based on the assumption that some of the new demand would be met through reduction of per capita use.

For planning purposes, in counties where a decline in population is anticipated (in either the high or low scenario or both), as a conservative approach it was assumed that 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)* category includes self-supplied residences with well permits issued by the NMOSE 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 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* 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 sector, interviews were held with farmers, farm agency employees, and others with extensive knowledge of agriculture practices and trends in each county. 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 sector across New Mexico. This decline was in all likelihood 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 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. While it is possible that drought will continue over a longer term, it is also likely that drought years will be interspersed with wetter years, and there is some potential for renewed agricultural activity 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 the 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 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 sector 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 percent 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 sector. The amount of decline projected is based on interviews with individuals knowledgeable about the agricultural economy in each county (Section 6.2). 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* 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 percentage growth or declines in the livestock sector were developed based on interviews with ranchers, farm agency employees, and others with extensive knowledge of livestock trends in each county (Section 6.2). The growth or decline rates were then multiplied by the 2010 water use to calculate future water demand.

The *commercial (self-supplied)* 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 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 the projected high and low population growth rates. In regions where the growth rate is negative, both the 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 the population growth is initially positive but later shows a decline, the water demand projection will remain at the higher level for the remainder of the planning period, again based on the administrative water supply and the value of water rights. . This method may be 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)* 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 (2014) to determine if growth is expected in this sector. Based on these interviews and information, high and low scenarios were developed to reflect ranges of possible growth. If water use in this category is low and limited additional use is expected, both the high and low projections are the same.

The *mining* 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 category were based on interviews with individuals involved in or knowledgeable about the mining sector. If water use in this category is low and limited additional use is expected, both the high and low projections are the same.

The *power* 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 category were based on interviews with individuals involved in or knowledgeable about the power sector. If water use in this category is low and limited additional use is expected, 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 acre-feet 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* (USBR, 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* (USBR, 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.

In reality 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.

6.5.2 Lower Pecos Valley Projected Water Demand

Table 6-5 summarizes the projected water demands for each water use category for each of the five counties, which were developed by applying the methods discussed in Section 6.5.1. As discussed in Section 6.3, population is projected to increase significantly in Chaves and Eddy counties in both the high and low projections and to slightly increase under the high projection in Lincoln and Otero counties and decline under the low projection. The population of De Baca County is predicted to decline significantly under both the high and low projections. The total projected water demand in the county in 2060 ranges slightly, from 29,799 to 38,940 acre-feet per year. Surface water supplies may be considerably lower in drought years, as discussed in Section 5.5.2, but the demand for water does not necessarily decrease when the supply is diminished.

Demand in the *public water supply* category is projected to increase in Lincoln, Chaves, Otero, and Eddy counties under the high scenario, proportional to the increasing population projections. However, use in this category is not projected to decline proportionally to the projections indicating declining population, because it is anticipated that existing water rights and domestic wells will continue to be used at the 2010 administrative supply level.

Projected water demand in the *domestic* categories is assumed to be proportional to the population growth rates, which are anticipated to increase in Lincoln, Chaves, Otero, and Eddy counties. The low projections for all counties assume current levels of use for the domestic category.

Table 6-5 Projected Water Demand, 2020 through 2060
Lower Pecos Valley Water Planning Region
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Use Sector	Projection	Water Demand (acre-feet) [a]					
		2010 [b]	2020	2030	2040	2050	2060
De Baca County							
Public water supply [c]	Low/High	392	392	392	392	392	392
Domestic (self-supplied) [c]	Low/High	29	29	29	29	29	29
Irrigated agriculture	High	57,249	57,249	57,249	57,249	57,249	57,249
	Low	57,249	54,845	54,845	55,417	55,417	55,417
Livestock (self-supplied)	High	397	238	258	298	318	357
	Low	397	199	218	258	298	318
Commercial (self-supplied) [c]	Low/High	3	3	3	3	3	3
Industrial (self-supplied)	Low/High	0	0	0	0	0	0
Mining (self-supplied)	Low/High	25	25	25	25	25	25
Power (self-supplied)	Low/High	0	0	0	0	0	0
Reservoir evaporation	High	8,958	8,984	9,090	9,156	9,235	9,353
	Low	8,958	8,958	8,958	8,958	8,958	8,958
Lincoln County							
Public water supply	High	3,501	3,529	3,652	3,669	3,669 [d]	3,669 [d]
	Low [c]	3,501	3,501	3,501	3,501	3,501	3,501
Domestic (self-supplied)	High	111	112	119	120	120 [d]	120 [d]
	Low [c]	111	111	111	111	111	111
Irrigated agriculture	High	20,076	20,076	20,076	20,076	20,076	20,076
	Low	20,076	18,450	18,912	19,153	19,153	19,373
Livestock (self-supplied)	High	307	184	215	230	246	261
	Low	307	169	184	200	215	246
Commercial (self-supplied)	High	2,382	2,409	2,541	2,576	2,576 [d]	2,576 [d]
	Low [c]	2,382	2,382	2,382	2,382	2,382	2,382
Industrial (self-supplied)	Low/High	1	1	1	1	1	1
Mining (self-supplied)	Low/High	0	0	0	0	0	0
Power (self-supplied)	Low/High	0	0	0	0	0	0
Reservoir evaporation	Low/High	0	0	0	0	0	0

[a] Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this table.
[b] Actual withdrawals (Longworth et al., 2013)
[c] Population growth rates are used to project future water demand in this sector. Where growth rates are negative, projected demand is set at 2010 withdrawals. The withdrawals in 2010 represent water that has been put to beneficial use and is a valid water right. For planning purposes it is assumed that valid water rights are maintained and will be used in the future.

Table 6-5 Projected Water Demand, 2020 through 2060
Lower Pecos Valley Water Planning Region
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Use Sector	Projection	Water Demand (acre-feet) [a]					
		2010 [b]	2020	2030	2040	2050	2060
Chaves County							
Public water supply	High	16,559	17,439	18,300	19,372	19,697	20,294
	Low	16,559	16,852	17,308	17,714	17,907	18,479
Domestic (self-supplied)	High	1,120	1,187	1,271	1,403	1,496	1,568
	Low	1,120	1,142	1,185	1,236	1,282	1,350
Irrigated agriculture	High	241,598	241,598	241,598	241,598	241,598	241,598
	Low	241,598	218,888	230,243	230,243	218,888	218,888
Livestock (self-supplied)	High	8,342	7,091	7,091	7,508	7,508	7,925
	Low	8,342	6,257	6,674	6,674	7,091	7,091
Commercial (self-supplied)	High	2,789	2,956	3,164	3,493	3,726	3,905
	Low	2,789	2,845	2,951	3,078	3,192	3,363
Industrial (self-supplied)	High	63	66	69	72	72	74
	Low	63	63	64	65	66	66
Mining (self-supplied)	Low/High	225	225	225	225	225	225
Power (self-supplied)	Low/High	0	0	0	0	0	0
Reservoir evaporation	Low/High	0	0	0	0	0	0
Otero County							
Public water supply	High	254	256	257	259	261	262
	Low [c]	254	254	254	254	254	254
Domestic (self-supplied)	High	159	161	162	163	165	166
	Low [c]	159	159	159	159	159	159
Irrigated agriculture	Low/High	1,980	1,980	1,980	1,980	1,980	1,980
Livestock (self-supplied)	High	40	26	28	32	34	36
	Low	40	24	28	28	30	34
Commercial (self-supplied)	High	32	32	32	32	33	33
	Low [c]	32	32	32	32	32	32
Industrial (self-supplied)	Low/High	0	0	0	0	0	0
Mining (self-supplied)	Low/High	0	0	0	0	0	0
Power (self-supplied)	Low/High	0	0	0	0	0	0
Reservoir evaporation	Low/High	0	0	0	0	0	0

[a] Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this table.
[b] Actual withdrawals (Longworth et al., 2013)
[c] Population growth rates are used to project future water demand in this sector. Where growth rates are negative, projected demand is set at 2010 withdrawals. The withdrawals in 2010 represent water that has been put to beneficial use and is a valid water right. For planning purposes it is assumed that valid water rights are maintained and will be used in the future.

Table 6-5 Projected Water Demand, 2020 through 2060 Lower Pecos Valley Water Planning Region

Use Sector	Projection	Water Demand (acre-feet) [a]					
		2010 [b]	2020	2030	2040	2050	2060
Eddy County							
Public water supply	High	15,465	16,784	18,664	19,864	20,293	21,374
	Low	15,465	16,511	17,651	18,172	18,405	19,040
Domestic (self-supplied)	High	203	222	256	288	315	340
	Low	203	218	239	255	271	286
Irrigated agriculture	High	188,226	188,226	188,226	188,226	188,226	188,226
	Low	188,226	155,286	160,745	160,745	166,204	166,204
Livestock (self-supplied)	High	1,335	934	1,001	1,135	1,135	1,135
	Low	1,335	801	868	1,001	1,001	1,001
Commercial (self-supplied)	High	504	3,110	2,300	1,800	1,020	950
	Low	504	2,170	1,680	1,040	850	800
Industrial (self-supplied)	Low/High	2,109	2,225	2,310	2,355	2,355	2,355
Mining (self-supplied)	High	9,303	9,130	8,845	8,650	8,485	8,400
	Low	9,303	8,975	8,710	8,425	8,260	8,195
Power (self-supplied)	Low/High	0	0	0	0	0	0
Reservoir evaporation	High	13,540	13,580	13,739	13,839	13,958	14,137
	Low	13,540	13,540	13,540	13,540	13,540	13,540
Total region							
Public water supply	High	36,172	38,399	41,265	43,557	44,311	45,992
	Low	36,172	37,510	39,107	40,033	40,459	41,666
Domestic (self-supplied)	High	1,622	1,711	1,836	2,004	2,125	2,223
	Low	1,622	1,660	1,723	1,791	1,852	1,935
Irrigated agriculture	High	509,130	509,129	509,129	509,129	509,129	509,129
	Low	509,130	449,449	466,725	467,538	461,642	461,862
Livestock (self-supplied)	High	10,422	8,474	8,593	9,203	9,240	9,714
	Low	10,422	7,449	7,972	8,161	8,635	8,689
Commercial (self-supplied)	High	5,710	8,510	8,041	7,905	7,358	7,466
	Low	5,710	7,431	7,048	6,535	6,459	6,579
Industrial (self-supplied)	High	2,173	2,292	2,380	2,428	2,428	2,430
	Low	2,173	2,289	2,375	2,421	2,422	2,422
Mining (self-supplied)	High	9,553	9,380	9,095	8,900	8,735	8,650
	Low	9,553	9,225	8,960	8,675	8,510	8,445

[a] Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this table.

[b] Actual withdrawals (Longworth et al., 2013)

[c] Population growth rates are used to project future water demand in this sector. Where growth rates are negative, projected demand is set at 2010 withdrawals. The withdrawals in 2010 represent water that has been put to beneficial use and is a valid water right. For planning purposes it is assumed that valid water rights are maintained and will be used in the future.

Table 6-5 Projected Water Demand, 2020 through 2060
Lower Pecos Valley Water Planning Region
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Use Sector	Projection	Water Demand (acre-feet) [a]					
		2010 [b]	2020	2030	2040	2050	2060
Total region (cont.)							
Power (self-supplied)	Low/High	0	0	0	0	0	0
Reservoir evaporation	High	22,498	22,564	22,829	22,994	23,193	23,491
	Low	22,498	22,498	22,498	22,498	22,498	22,498
Total regional demand	High	597,279	600,458	603,168	606,119	606,519	609,094
	Low	597,279	537,511	556,408	557,651	552,476	554,097

[a] Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this table.
[b] Actual withdrawals (Longworth et al., 2013)
[c] Population growth rates are used to project future water demand in this sector. Where growth rates are negative, projected demand is set at 2010 withdrawals. The withdrawals in 2010 represent water that has been put to beneficial use and is a valid water right. For planning purposes it is assumed that valid water rights are maintained and will be used in the future.

Water use in all five counties occurs primarily in the *agricultural* category, and interviews (Section 6.2) indicated that the agricultural sector may decline in the future due to the aging population of farmers. Although groundwater is used for most irrigation, surface water, which is highly susceptible to drought, supplies 30 percent of irrigated agriculture in the planning region (although half of surface water irrigators have supplemental wells to meet any shortfalls in supply). Therefore, the recent drought, along with the recession, is thought to be driving some of the decline. While it is possible that drought conditions will continue over a longer term, it is also likely that drought years will be interspersed with wetter years, and there is some potential for renewed agricultural activity as a result. In addition, a reduction in demand does not mean that additional water would be available for appropriation. Water that has been applied to beneficial use represents a valid water right that may be licensed or adjudicated. As demand shifts over time, transfers between water use sectors may occur through sales and leases. Thus even though the agricultural sector may decline, the high projection for all five counties assumes that overall water uses will remain at 2010 levels since water rights have economic value and will continue to be used.

For the low scenario, some decrease in agricultural use is projected in four of the five counties, as summarized below:

- In De Baca County, agriculture water use is projected to drop to 80 percent in 2020 and then rise to 85 percent of current levels from 2040 through 2060.
- For the portion of Lincoln County in the Lower Pecos Valley region, water use in 2020 is projected to reach 65 percent of the 2010 level and increase to 85 percent by 2060.
- Chaves County is attracting manufacturing and other industrial businesses, and some agricultural land will eventually be sold for industrial and commercial uses. Therefore, the low scenario anticipates groundwater usage at 90 percent of the 2010 level in 2020, a rise to 95 percent in 2030, and then a decline and leveling off at 90 percent by 2050.
- The small portion of Otero County in this region relies solely on groundwater for irrigated agriculture, and the 2010 water use was assumed to hold steady throughout the forecast period.
- In Eddy County, the low scenario anticipates that the sale of water rights will permanently lower the percentage of water used in the agricultural sector. Irrigated agriculture is projected to attain 70 percent of the 2010 level in 2020 and, with an improvement in the drought situation, will reach 80 percent in 2050, staying at that level for the remainder of the forecast period.

Livestock water use is projected to decline in all five counties in the region:

- In De Baca County, water usage for livestock is projected to be at 60 percent of the 2010 level in 2020 under the high scenario and at 50 percent in the low scenario. By 2060, recovery will be at 90 percent in the high scenario and 80 percent in the low scenario, as some ranching families abandon this occupation.

- Livestock water use in Lincoln County is projected to reach only 60 percent of the 2010 level in 2020 in the high scenario and 55 percent in the low projection. By 2060 livestock water use is forecast to reach 85 percent of the 2010 level in the high scenario and 80 percent in the low scenario.

- Livestock in Chaves County is primarily milk cows, and the dairy industry is expected to remain the backbone of agriculture in the county. Livestock water use is projected to be at 85 percent of the 2010 level in 2020 in the high scenario and 75 percent in the low scenario. By 2060, the percentages of 2010 use are expected to rise to 95 percent and 85 percent respectively. Besides water availability, the number of milk cows depends on the price of wholesale milk and the cost of feed.

- In 2020 the livestock sector in Otero County is projected to reach only 65 percent of 2010 use under the high scenario and 60 percent under the low scenario. By 2060 the respective rates will be 90 percent and 85 percent of 2010 usage.

- Livestock in Eddy County is projected to consume 70 percent of the 2010 level in 2020 under the high scenario and 60 percent under the low. By 2040, the use will recover to 85 percent in the high projection and 75 percent in the low projection and remain at that level through 2060.

- The amount of water needed for future livestock use may be greater than the estimates developed based on the 2010 administrative supply. See Appendix 6-C for an analysis of livestock water use and the potential increase in future demand.

The *commercial* category now includes oil exploration using the water-intensive hydraulic fracturing technique (previously, all oil and gas drilling was categorized by NMOSE as either mining or industrial use). Since 2010, water demand for this type of drilling has grown substantially in Eddy County. The projections for this category include a high and low scenario to accommodate the volatile nature of the oil drilling industry. By 2030, drilling will level off, as most wells are expected to be drilled by 2025, even if the price of oil dips. The decline will continue throughout the forecast period.

Mining activity, including some oil and gas drilling, takes place throughout the region. Historically, mining of gold and silver occurred in Lincoln County. De Baca, Chaves, Lincoln, and Otero counties have a small amount of mining (sand and gravel) that is projected to remain steady throughout the forecast period. The bulk of the mining in the region, however, takes place in Eddy County:

- Most of the water demand projected in the mining category in Eddy County is for oil and gas exploration. If the price of oil stays above $60 a barrel, the Permian Basin (covering both Eddy and Lea counties) could support 2,000 new oil wells per year between now and 2020. The high scenario developed for this RWP update contemplates the oil price staying above that level, while the low scenario anticipates the price dipping below that level in the near future but picking up again after 2020, thus spreading out new drilling through 2030. Most of the water used in drilling is fresh water, but some oil companies in Eddy County are experimenting with brackish water.

- Eddy County is home to two large potash-mining companies, which are big users of water. As mentioned in Section 6.2.3, one of the companies, Mosaic, is closing down one of its potash mines. A decline in mining water use over the forecast period is projected due to the closure of that mine and the fact that some oil drilling water use (i.e., for hydraulic fracturing) is being transferred to the commercial category.

Only Chaves and Eddy counties have much *industrial* activity. In Chaves County industrial water use is projected to increase modestly, as Roswell is attracting businesses to the area, a trend that will continue.

No water is used for *power* generation in the Lower Pecos Valley region and none is expected in the future.

The Lower Pecos Valley region projections include significant water use in the *reservoir evaporation* category due to the presence of Lake Sumner Reservoir, Brantley Lake, and Lake Avalon. Though these reservoirs are almost entirely for the benefit of the CID, the use is recorded in the counties in which the reservoirs are located. As discussed in Section 6.5.1, the projected demand is based on 2010 reservoir surface areas so that it can accurately be compared to the 2010 administrative water supply. Increases in reservoir evaporation could impact the water supply available to the region.

7. Identified Gaps between Supply and Demand

Estimating the balance between supply and demand requires consideration of several complex issues, including:

- Both supplies and demands vary considerably over time, and although long-term balanced supplies may be in place, the potential for drought or, conversely, high flows and flooding must be considered. In general, storage, including the capture of extreme flows for future use, is an important aspect of allowing surface water supplies to be used when needed to meet demand during drought periods (i.e., reservoir releases may sustain supplies during times when surface water supplies are inadequate).

- In wet years when more water is available than in 2010, irrigators can increase surface water diversions up to their water right and reservoirs will fill when inflow exceeds downstream demand, provided that compact requirements are satisfied, to increase storage for subsequent years. Thus, though not quantified, the withdrawals in wet years may be greater than the high projection.

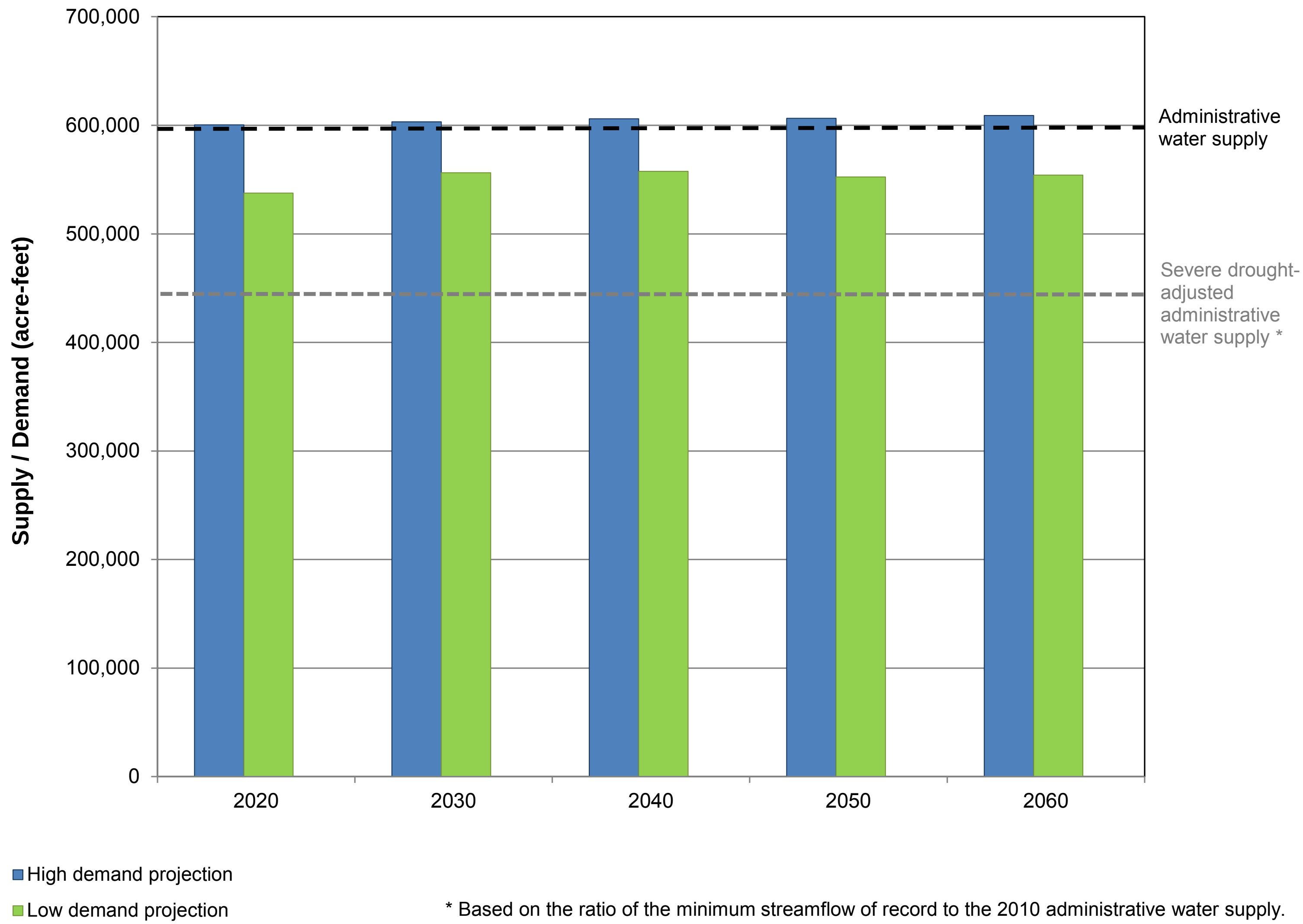
- Supplies in one part of the region may not necessarily be available to meet demands in other areas, particularly in the absence of expensive infrastructure projects. Therefore comparing the supplies to the demands for the entire region without considering local issues provides only a general picture of the balance.

- As discussed in Section 6.5.1, the fluctuations in reservoir evaporation are expected to be much greater than the high/low projected range developed for this balance. When comparing the projected demands to the administrative water supply, which is based on 2010 water withdrawals, 2010 surface areas of reservoirs were used to avoid an unrealistic scenario of excess available water. The actual amount of water that will be used for reservoir evaporation is dependent on the surface area of the reservoir and temperatures. During the first year of a drought when there is surface water in storage, the reservoir evaporation could be similar to 2010 use, but after subsequent years of drought, when storage and surface areas are lower, reservoir evaporation would be lower.

- As discussed in Section 4, there are considerable legal limitations on the development of new water supplies, which affects the ability of the region to prepare for shortages.

- Besides quantitative estimates of supply and demand, numerous other challenges affect the ability of a region to have adequate water supplies in place. Water supply challenges include the need for adequate funding and resources for infrastructure projects, water quality issues, location and access to water resources, limited productivity of certain aquifers, and protection of source water.

Despite these limitations, it is useful to have a general understanding of the overall balance of the supply and demand. Figure 7-1 illustrates the total projected regional water demand under the high and low demand scenarios and also shows the administrative water supply and the drought-adjusted water supply. As presented in Section 5.5, the region's administrative water supply is nearly 600,000 acre-feet and the drought supply is 443,296 acre-feet, or about 74 percent of a normal year administrative water supply. Future water demand projections do not reflect substantial growth in water use (597,279 acre-feet in 2010 to 609,094 acre-feet in 2060 [Table 6-5]), because the water demand for the predicted growth in population in Chaves and Eddy counties will be offset by reductions in per capita consumption. Any change in economic development will likely rely on transfer of existing water supplies, so an increase in water demand is not expected.



* Based on the ratio of the minimum streamflow of record to the 2010 administrative water supply.

Note: Tribes and pueblos in New Mexico are not required to provide water use data to the State. Therefore, tribal water use data are not necessarily reflected in this figure.

LOWER PECOS VALLEY
REGIONAL WATER PLAN 2016

Available Supply and Projected Demand

Figure 7-1

However, even without significant growth in demand, major supply shortages are indicated in drought years. Because of its reliance on surface water, the region has a degree of vulnerability to prolonged drought, and the estimated shortage in drought years is expected to range from about 94,000 to 165,800 ac-ft/yr (as explained in Section 5.5.2). With an administrative supply of 416,100 acre-feet from groundwater and a surface water supply of 27,200 acre-feet, the total administrative supply during a severe drought is expected to be 443,300 acre-feet. Even though the region has actively pursued actions to manage water resources (installation of meters in 1967 in the Roswell Basin, purchase and retirement of water rights by NMISC, and implementation of well fields to pump water into the Pecos River), the region is still vulnerable to drought as evidenced by the near priority call by CID in 2013. The region should continue to explore options for developing shortage-sharing agreements, protecting watershed health for the region's surface water supplies, and identifying alternative groundwater supplies.

8. Implementation of Strategies to Meet Future Water Demand

An objective of the regional water planning update process is to identify strategies that will help the region to balance the gap between supply and demand and address other future water management challenges, including infrastructure needs, protection of existing resources and water quality, and the need to maximize limited resources through water conservation and reuse. The Lower Pecos region considered a variety of strategies for addressing these water management challenges in the 2001 plan and brought new suggestions to the update.

This RWP update is building on the original water plan and is considering strategies that will enhance and update, rather than replace, the strategies identified in the accepted RWP. The status of strategies from the 2001 regional water plan is summarized in Section 8.1. Additional strategies recommended in this RWP update—including a comprehensive table of projects, programs, and policies, key collaborative projects, and recommendations for the state water plan—are discussed in Section 8.3.

8.1 Implementation of Strategies Identified in Previously Accepted Regional Water Plan

The steering committee reviewed each of the water management strategies recommended in the 2001 plan and indicated that most are still relevant, though some are being refocused as new recommended strategies. The steering committee would like to remove the Cloud Seeding and Interstate Pipeline alternatives from the future strategies. Importing water from other basins is another controversial topic that does not have widespread support, but the steering committee would support additional research on this topic. Each of the strategies in the 2001 plan is reviewed and the implementation status summarized in Table 8-1, as well as in Appendix 8-A.

Table 8-1. Implementation Status of Strategies Identified in Accepted Plan Lower Pecos Valley Water Planning Region
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Strategy	Status
Managed Well Field Operations	The Seven Rivers and Lake Arthur well fields were created to meet the requirements of the 2003 Pecos Settlement Agreement and put into use since the 2001 plan was developed. The impact of these well fields combined with the unprecedented drought is concerning for the region. Additional studies are needed and should focus on evaluation of water yield, impact on groundwater storage, and increased monitoring. Ensuring that the well fields are complying with the goals of the Settlement and investigating well field alternatives are both highly recommended.
Desalination	Desalination is both a groundwater and surface water concern in this region. The amount of brackish water reserves in the planning region is extensive and estimated to be on the order of hundreds of millions of acre-feet. The salt springs at Malaga Bend contribute up to 172,000 tons of salt per year into the Pecos River. The Pecos River Water Quality Coalition was formed in 2010. Bureau of Reclamation was the project lead on several recent studies. Better policy on ownership and definition of beneficial use of desalinated water is needed for further development of brackish water as an additional water supply source.
Interstate Pipeline	Importation of water from other regions has little support from the steering committee and would require State or federal level policy decisions. The committee would rather see water conservation and better efficiency with current water than take water from another region.
Import Water from Salt Basin	This alternative was not implemented and is not a priority moving forward.
Cloud Seeding	This alternative was not implemented and is not a priority moving forward.
Reduce Conveyance Losses	The relationship between agricultural use and shallow groundwater recharge is complex. Reducing conveyance losses may reduce recharge to groundwater. More studies are needed to determine the best path forward.

Table 8-1. Implementation Status of Strategies Identified in Accepted Plan Lower Pecos Valley Water Planning Region
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Strategy	Status
Agricultural Water Conservation	The steering committee encourages the availability of conservation programs. Both federal and State agencies have reduced the funding for conservation technologies. Low energy precision application (LEPA) irrigation and low-water-use crops were both suggested in the 2001 plan and have both been implemented. The high salt content of the water in this region can be a limitation to LEPA, as larger volumes of water are needed to flush the root zone from salt buildup. Policies that do not encourage agricultural water conservation should be removed. Focusing on increasing efficiency and reducing conveyance losses are the future strategies. However, this benefit is limited, as upstream users' losses may be downstream users' supply.
Municipal Water Conservation	The steering committee would like to see increased efforts to reduce municipal water usage by metering domestic wells, reusing wastewater, performing water audits and leak detection tests, and developing water conservation plans as part of their water development plans.
Industrial Water Conservation	Managing industrial water use is a much larger concern now than when the 2001 plan was written. The volumes of produced water generated from oil field operations continue to increase in this region, and projects are needed to promote the reuse of this water. Eddy County alone is currently producing 118,000 acre-feet per year (ac-ft/yr) of produced water. This is not insignificant when the projected shortfall in regional supply is 25,000 ac-ft/yr. Programs offering businesses incentives for produced water reuse should be developed.
Moving Reservoir Storage	This alternative was intended to give the Carlsbad Irrigation District flexibility to store water in northern reservoirs to reduce losses. Restrictions to adjustments in reservoir storage limits need to be assessed.
Construct Additional Reservoirs	This alternative hoped to capture water if existing reservoirs spilled. Drought conditions have limited the number of spills in recent years. The Pecos River Compact restricts cumulative storage in Pecos Basin reservoirs to a maximum of 176,500 acre-feet.

Table 8-1. Implementation Status of Strategies Identified in Accepted Plan Lower Pecos Valley Water Planning Region
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Strategy	Status
Reduce Reservoir Surface Area and dewater McMillan Delta	Deepening reservoirs or reducing surface water area using berms or dewatering were suggested to reduce evaporative losses. The region was not able to implement this, but would still like to see this considered in the future.
Riparian Vegetation Management	A number of projects have been implemented in New Mexico, but an unprecedented drought followed these projects and water yield was undetermined at this time. Nonnative phreatophyte removal is ongoing in the area. This alternative does not create new water sources, but may reduce non-beneficial diversions of the resource.
Enhanced Water Market	For a water market place to exist, a water rights adjudication needs to be complete. Increased oil and gas extraction in the region has significantly changed the types of water use.
Enhanced Administrative Enforcement	Enforcement of existing permits, decrees, and contracts is essential. Enhanced administration is still needed. Water rights abandonment after sale or transfer is not necessarily monitored or enforced. Policies on treatment plans for fallowed land are needed for control of weeds and invasive species. Metering of all water uses (including domestic wells) is highly recommended.
Compact Compliance	Compact compliance is paramount to regional water planning. All projects, policies, and programs have to be evaluated as to impacts and compliance with the Pecos River Compact. Compact compliance governs water use and business development in this region more than any other factor.

8.2 Water Conservation

Municipal water use is generally low in the Lower Pecos Valley Water Planning Region, and water conservation programs are already in place, many having been implemented as recommended in the 2001 accepted plan; therefore, few new water conservation projects are included in this RWP update. However, water providers in the region will continue to implement their existing water conservation programs and drought contingency ordinances. As shown in Table 8-1, several water conservation and water reuse projects have been completed since the original plan was accepted in 2001.

8.3 Proposed Strategies (Water Programs, Projects, or Policies)

In addition to continuing with strategies from the previous plan, the Lower Pecos Valley region discussed and compiled new project, program, and policy (PPP) information identified key collaborative projects, and provided recommendations for the state water plan. The new policy and program ideas were developed primarily through discussion at steering committee meetings and are shown in Appendices 8-A and 8-B. The new recommendations included in this section were prepared by the Lower Pecos Regional Water Planning Steering Committee and other stakeholders and reflect their interest and intent. The recommendations made by the steering committee and other stakeholders have not been evaluated or approved by NMISC. Regardless of the NMISC's acceptance of this RWP, inclusion of these recommendations in the plan shall not be deemed to indicate NMISC support for, acceptance of, or approval of any of the recommendations, PPP information, and collaborative strategies included by the regional steering committee and other stakeholders.

8.3.1 Comprehensive Table of Projects, Programs and Policies

Over the two-year update process, several meetings were held with stakeholders in the Lower Pecos Valley region. These meetings identified the program objectives, presented draft supply and demand calculations for discussion and to guide strategy development, and provided an opportunity for stakeholders to provide input on the PPPs that they would like to see implemented (Section 2). Information was requested during several open meetings, and requests for input were also e-mailed to all stakeholders that had expressed interest in the regional water planning process. Project ideas submitted to the steering committee are included in the PPP table in Appendix 8-A, but they are not ranked or prioritized.

In addition to the project and program ideas submitted by regional stakeholders, the NMISC compiled the Water Trust Board (WTB) and Infrastructure and Capital Improvement (ICIP) data for 2016 in this region. These projects are included in Appendix 8-B and were not evaluated by the steering committee; they typically consist of water system and sewer system infrastructure improvement projects in the region.

The PPP list also contains several watershed restoration projects, including some identified in the New Mexico Forest Action Plan. New Mexico State Forestry Division provides annual updates to the recommended watershed restoration projects in the New Mexico Forest Action Plan, and the region is supportive of those ongoing watershed restoration projects, even those that are not specifically identified in the PPP list.

The information in Appendices 8-A and 8-B has not been ranked or prioritized and represents a snapshot of the PPPs that regional stakeholders are interested in pursuing. Appendix 8-A includes projects both regional in nature (designated R) and those that are specific to one system (designated SS). The Appendix 8-A table also identifies each PPP by category, including water and wastewater system infrastructure, water conservation, watershed restoration, flood prevention, water reuse, water rights, water quality, and data collection. Similar tables were developed in all 16 regions to create a State database of current water projects and programs.

The PPPs identified for the Lower Pecos Valley region, are summarized below.

- *Groundwater Monitoring:* A top priority is increased funding for water quality monitoring and for mapping groundwater levels and extent. Studies conducted in the past have identified favorable recharge areas that should be protected from development.

- *Watershed Restoration and Management:* The Pecos River Compact is based on 1947 conditions, and every effort should be made to maintain the watershed to 1947 conditions. Several watershed programs have been conducted and are ongoing (Mescalero Turkey Pen Canyon Improvements, U.S. Forest Service Projects, Bureau of Land Management, etc.). The National Environmental Policy Act (NEPA) process is often one of the limiting factors to implementing these projects.

- Funding for *NEPA/EIS* compliance*:* The region needs more support to help smaller communities through the NEPA and environmental impact statement (EIS) process required to implement many of these regional projects.

- *Conservation Funding:* Funding programs are needed for implementation of water conservation technology for agriculture, municipal and industrial users. Careful review of policies that do not encourage water conservation should also be considered (such as oil and gas water use, groundwater mining, etc.).

- *Drought Preparedness:* Drought restrictions need to be better enforced, and public education on water conservation needs to be increased. Consider imposing water use limits during non-drought conditions.

- *Produced Water Reuse:* Policy changes are needed to make the reuse of produced water more feasible. NMED regulations need to be re-evaluated to allow lower water quality standards for aquifer storage and recovery and direct Pecos River releases. Additional uses for the produced water are highly encouraged. Produced water research is ongoing in this region and supported by the Water Resources Research Institute (WRRI) and the PVWUO.

- *Reoperate "Leaky" Reservoirs:* Reoperate or reclassify particularly leaky reservoirs to serve as recharge locations rather than storage locations. Two Rivers Reservoir is one example of these types of locations. Significant red tape and policy changes would need to be made for this to be implemented.

- *Increase Recharge:* This is similar to the watershed management alternative, as tree thinning is a key way to increase mountain front recharge. This category also includes aquifer storage and new project ideas to save water by recharging it instead of letting it evaporate. Recharge areas have been identified in previous studies and should be preserved from development.

- *Aquifer Storage and Recovery:* Aquifer storage and recovery should be considered for the region. Drought conditions may make surplus surface water in short supply.

- *Regional System Collaboration:* Small rural water systems should be encouraged to work together to pool resources for improvements and cost sharing.

- *Domestic Well Permits and Metering:* The steering committee would like to see metering requirements for all new domestic well permits (and impairment analysis conducted if appropriate). A flat fee imposed when the permit is issued could be used toward a general fund that purchases water rights that can be retired. This would help address over-appropriation in the basin. Other ideas include reducing the permitted amount on all new and replacement domestic wells, adjusting regulations for domestic wells used to supply RV parks, and increasing inspection of domestic wells by NMOSE.

- *Water Right Abandonment Monitoring:* This strategy is similar to the Enhanced Administration discussed in the 2001 plan. The committee would especially like to see better land management when water rights are retired or transferred off the land. Fields left fallow present nuisance problems with weeds and invasive species. In other cases the water rights are sold, but the owner continues to irrigate illegally. Stronger monitoring for both types of activities is needed.

- *Incentives to Preserve Agricultural Water:* Incentives and rate changes need to be implemented to create thoughtful municipal and industrial water development without detriment to agricultural water rights. One example would be a point system in new municipal and industrial developments, with higher points given for water reuse or alternative water sources.

- *Protect New Mexico Water:* The State of New Mexico should maintain primacy on all water resources used for distribution within the state.

- *Limit New Uses:* The steering committee does not support any new water uses or appropriations that diminish the current supply. One example of an undesirable new use is the current application from BOPCO for a new appropriation of 2,000 acre-feet per year in the Carlsbad Underground Water Basin.

- *Close the Basin:* The basin is fully appropriated, but it has not been closed. The steering committee recommends that the State Engineer close the basin.

8.3.2 Key Strategies for Regional Collaboration

Prioritizing projects for funding is done by each funding agency/program, based on their current criteria, and projects are reviewed in comparison to projects from other parts of the state. Consequently, the regional water planning update program did not attempt to rank or prioritize projects that are identified in Appendix 8-A or 8-B. However, identifying larger regional collaborative projects is helpful to successful implementation of the regional plan. At steering committee meetings held in 2015 and 2016, the group discussed projects/programs that would have a larger regional or sub-regional impact and for which there is interest in collaboration with entities in other water planning regions to seek funding and for implementation.

The group used an informal process of discussing and refining the definition of potential collaborative projects to determine the projects of greatest interest. Key programs and collaborative projects identified by the steering committee and Lower Pecos Valley region stakeholders include:

- *Managed Well Field Operation:* Minimize well field impacts and explore alternatives.

- *Agricultural Water Conservation*: Increase efficiency and preserve agricultural rights.

- *Municipal Water Conservation:* Encourage water planning, infrastructure upgrades, and leak detection. Collaboration between small rural providers will allow pooling of resources and staff.

- *Industrial Water Conservation*: Produced water reuse is a key issue for this region and could potentially reduce water shortages. Greater measures need to be taken to make produced water reuse more feasible.

- *Watershed Management*: Management and protection of recharge areas is important.

- *NEPA/EIS Support:* Increase funding for NEPA or EIS analysis required for project implementation.

- *Increase Recharge*: Several ideas are presented to increase recharge, including easing restrictions on water quality used for aquifer storage and river discharge, reoperating leaky reservoirs as recharge points for aquifers, and better management of watersheds.

- *Compact Compliance*: Additional studies are needed to develop alternatives to meeting the Pecos River Compact. Are the impacts of the current strategies as anticipated, or have there been unintended consequences?

In order to move forward with implementing the key collaborative projects, additional technical, legal, financial, and political feasibility assessment may be required. A detailed feasibility assessment was beyond the scope and resources for this RWP update.

8.3.3 Key Program and Policy Recommendations

The legislation authorizing the state water plan was passed in 2003. This legislation requires that the state plan shall "integrate regional water plans into the state water plan as appropriate and consistent with state water plan policies and strategies" (§ 72-14-3.1(C) (10)). For future updates of the state water plan, the NMISC has asked the regions to provide recommendations for larger programs and policies that would be implemented on a state level. These are distinct from the regional collaborative projects listed in Section 8.3.2 and the PPPs listed in Appendices 8-A and 8-B in that they would be implemented on a state rather than a regional or system-specific level. The State will consider the recommendations from all of the regions, in conjunction with State-level goals, when updating the state water plan.

After group discussion, the Lower Pecos Valley region identified the following recommendations for PPPs to be considered in the state water plan:

- *Enhanced Water Right Administration*: Increased enforcement of existing policies, which will require increased staffing and overall capacity at the NMOSE.

- *Reduce State Water Losses:* Evaporative losses from reservoirs and conveyance channels are significant and should be addressed.

- *Produced Water Reuse:* Eddy County produces some of the largest volumes of produced water in the country. Projects to make this water more readily reusable are a high priority. The PVWUO, along with WRRI, has been very active in produced water research, holding four public meetings on this issue in 2016 alone. A task force will be necessary between the Oil Conservation Division, NMED, and NMOSE to make produced water more available for reuse.

- *Modify NMED Regulations:* The current water quality standards for use in injection for aquifer storage, discharge to the Pecos River, or for direct reuse are too stringent and make reuse difficult and expensive.

- *Interbasin Transfers:* The region is generally against transfers between basins, but feels that the decision is made at the State level rather than regionally.

The 2016 Regional Water Plan characterizes supply and demand issues and identifies strategies to meet the projected gaps between water supply and demand. This plan should be added to, updated, and revised to reflect implementation of strategies, address changing conditions, and to continue to inform water managers and other stakeholders of important water issues affecting the region.

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Appendix 2-A

Master Stakeholder List

Lower Pecos Valley Region 10 RWP Master Stakeholder List

Updated June 14, 2016

Last	First	Affiliation/Category
Achen	Aspen	De Baca County Extension Service
Aherns	Bill	Carlsbad Irrigation District
Ananins	Beverly Allen	
Anderson	Phelps	
Ballard	Dale	Carlsbad Irrigation District
Ballard	Mary Lou	
Balok	Aron	Pecos Valley ACD
Barraza	Sandra	Chavez County Extension Officer
Bason	Stephanie	Upper Hondo SWCD
Baumann	J.R.	Village of Ruidoso
Bean	Raelynn	Central Valley Electric Coop
Bock	Judy	Carlsbad Soil & Water Conservation
Bonnell	Kristi	Upper Hondo SWCD
Bordegaray	Angela	New Mexico Interstate Stream Commission (NMISC)
Bosen	Stephanie	Upper Hondo SWCD
Bowman	Dale	HydroResolutions, LLC
Boyda	Eric	City of Ruidoso
Buckley	Roger	City of Roswell
Bunt	Michael	Economic Development Director, Artesia Chamber of Commerce
Burch	Phillip	Mayor, City of Artesia
Calvani	Dean & Amy	Calvani Pecan Company
Cantrell	Mike	Carlsbad Irrigation District Dam Watcher
Carter	Philip	District Conservationist, USDA NRCS
Collier	Glenn	Commissioner, Eddy County
Combs	Robert	Navajo Refining
Coulton	Jean	Trustee, Village of Capitan
Cox	Janet	Water Right Holder
Crawford	Richard	
Crockett	Susan	Commissioner, Eddy County
Davis	Brad	Realtor, Prudential Enchanted Lands Realty
David	Stella	Commissioner, Eddy County
Defer	Robert	President, Chamber of Commerce
Derrick	Lewis	Eddy County
D'Llayne	Bruce	District Conservationist
Donaldson	Brett	Executive VP, Pioneer Bank
Duemling	Bill	NMISC Roswell Office

Note: Those interested in developing collaborative projects or ongoing planning efforts may contact the NMISC Regional Water Planning Manager for further information about the region's stakeholders.

Lower Pecos Valley Region 10 RWP Master Stakeholder List

Updated June 14, 2016

Last	First	Affiliation/Category
Dunigan	Steve	Planning Director, Ruidoso Downs
Dunnigan	George	Realtor, Dunnigan Realty
Ellington	Brent	New Mexico Interstate Stream Commission
Florez	Luis	National Park Service, Compliance Coordinator
Fry	Larry	City Manager, Roswell
Gallegos	Louis	Public Works Director, Ft. Sumner
Gormley	Leon	
Goodale	Scott	Mosaic Potash
Griffith	Cheryl	Rancher Lakewood
Hagelstein	Sam	
Hager	Shay	District Manager, Lea Soil and Water Conservation District
Haraden	Pete	U.S. Forest Service
Hennighausen	Fred	Pecos Valley Artesian Conservation District
Hernandez	Michael	City of Carlsbad
Hill	Terry	Mayor Pro Tem, City of Artesia
Hita	Elliott	Navajo Refining
Hobson	Aubrey	City Clerk, Artesia
Holdeman	Wade	Fort Sumner Irrigation District
Houghton	Woods E.	Eddy County Agriculture Extension Agent
Hughes	Debbie	NMACD
Hyatt	Jacqueline	
Jenkins	Jay	President & CEO, Carlsbad National Bank
Johnson	Laura	
Johnson	Marlin	Planning and Zoning Director
Joop	Diane	National Cave & Karst Research Institute
Kelley	Jeanne	Director of Tourism, Village of Ruidoso
Keller	Ray	Bureau of Land Management
Kesler	Michael	District Manager, New Mexico Environment Department
King	Cindy	President, DeBaca County Chamber of Commerce
Klein	Lex	Hope Community Ditch
Kohler	Jeremy	Branch Manager, Farm Credit of New Mexico
Land	Lewis	New Mexico Bureau of Geology/NCKRI
Landfair	Byron	City of Artesia
Lathrop	Dan	Hagerman Irrigation District
Lee	Debi	Village of Ruidoso
Levine	Lacy	New Mexico Department of Agriculture
Lewis	Candace	Office Manager, Chamber of Commerce

Note: Those interested in developing collaborative projects or ongoing planning efforts may contact the NMISC Regional Water Planning Manager for further information about the region’s stakeholders.

Lower Pecos Valley Region 10 RWP Master Stakeholder List

Updated June 14, 2016

Last	First	Affiliation/Category
Longowski	Suzanne	National Cave & Karst Research Institute
Mainello	Joe	
McCroskey	Steve	Eddy County Planning
McCutcheon	Steve	City Administrator, Carlsbad
McKee	Michael	Vice President and Refinery Manager, Navajo Refining Company, LLC
Melvin	Amanda	Carlsbad Main Street
Mendez	Thomas	MAT-DRMP
Miller	Grace	Reporter
Morris	William	Eddy County General Services Director
Mulcahy	John	President, CEO, Chavez County Economic Development Corp.
Nelson	Morgan	Chavez County Flood Commission
Norwood	Kelly	Water Quality Program Manager, White Sands Missile Range
Padilla	Thora	Director, Mescalero Apache Tribe Division of Resource Management & Protection
Parker	Dara	Field Representative, Senator Martin Heinrich
Pearson	Royce	Commissioner, Eddy County
Prude	Mike	Seven Rivers, Inc. Pecan Orchards
Ponce	Zack	Reporter, Current-Argus
Powell	Jackie	
Quintana	Hubert	Southeastern New Mexico Economic Development District
Riggs	Stanton	County Manager, Chavez County
Rose	Bobbye	Community Development Director, Village of Ruidoso
Rudometkin	Rick	Eddy County Manager
Russ	James	Realtor, Connect Realty
Salas	Rafael	Mayor Pro-Tem, Village of Ruidoso
Salvarrey	Francisco	OCCAM Consulting Engineers
Shug	Arden	
Smith	Dick	Sureste Resource and Development Council
Sparks	Alan	Executive Director, Ft. Sumner Community Development Corp.
Strickland	Kay	Village Clerk, Capitan
Sena	Rob	Village of Ruidoso
Taylor	Nita	Manager, Lincoln County
Temple	Curt	Planning Director, Lincoln County
Thomas	Nathan	Mortgage Broker/Rancher, Ruidoso Mortgage
Torrez	Arthur	City of Roswell
Townsend	Jim	Holly Energy
Tracy	Louise	

Note: Those interested in developing collaborative projects or ongoing planning efforts may contact the NMISC Regional Water Planning Manager for further information about the region’s stakeholders.

Lower Pecos Valley Region 10 RWP Master Stakeholder List

Updated June 14, 2016

Last	First	Affiliation/Category
Turner	Rob	Loan Officer, First National Bank
VanDerVeen	Debbie	
Veni	George	Executive Director, National Cave and Karst Research Institute
Walterscheid	James	Commissioner, Eddy County
Walterscheid	Ronnie	Walterscheid Heifers, Inc.
Ward	Ryan	Water Policy Analyst, New Mexico Department of Agriculture
Waters	John	Carlsbad Department of Development
West	Allen	Fort Sumner Irrigation District
Wieber	David	Banker, City Bank of New Mexico
Whitlock	Janelle	Chamber of Commerce
Wilcox	Jim	NMISC Commissioner
Williams	Timothy	Pecos River Water Master
Zemlick	Katie	
		New Mexico Environment Department
		Hagerman, New Mexico Fish and Wildlife
		Pardue Limited Company
		Hagerman-Dexter Soil and Water Conservation District (SWCD)

Note: Those interested in developing collaborative projects or ongoing planning efforts may contact the NMISC Regional Water Planning Manager for further information about the region’s stakeholders.

Appendix 2-B

Summary of Comments on Technical and Legal Sections (Single Comment Document) and Other Public Comments

Lower Pecos Valley Regional Water Plan
Compilation of Comments on Draft Plan

Comment Number	Page Number	Paragraph or Section Number	Comment
1	30	6.2.1 paragraph 2	The paragraph states that a clinic formerly present in the county has closed. The De Baca Family Practice Clinic is thriving and a great asset to the community. It is one of the community's largest employers.
2	30	6.2.1 paragraph 2	Update: Fort Sumer *IS* building a new senior center.
3	30	6.2.1 paragraph 2	The following sentence is not factual, "Older residents are leaving because they need to be closer to healthcare facilities." The older residents that leave because they need to closer to healthcare facilities are those that need to be checked into facilities like a nursing home.
4	30	6.2.1 paragraph 3	The paragraph states that a good deal of agricultural land is fallow. A total of 1,068,067 acres is in farm and ranch land. De Baca County itself is 1,493,760 acres, so 72% of the land in De Baca County is currently in agriculture. We rank 6th in the state in Alfalfa production and 19th in Beef Cows. (2014 NM Agriculture Statistics)
5	30	6.2.1 paragraph 3	The paragraph states that vegetable growers in the county have almost disappeared. This is not a factual statement, there is no statistics to support this. In fact a new local farmers market has opened within the last year.
6	30	6.2.1 paragraph 3	The paragraph states that ranchers have sold off their cattle completely. Nowhere does it relate the selling of cattle to the drought and while producers are restocking the process is slow. The Baca County Assessors office shows cattle numbers to be 34,565 in 2010 and then dropping to 17,582 in 2013 (which was the peak of the drought) then climbing to 25,285 in 2015 (which was when moisture returned).
7	30	6.2.1 paragraph 3	The last sentence says that older ranchers are selling their ranches to buyers from Texas and Kansas. There is nothing to show the correlation that the ranches being sold are sold because the owner is old. Ranches that have been sold are for a variety of reasons and those reasons exist everywhere not just in De Baca County. When these ranches sell there is a family that moves onto them so we have not lost people, cattle, or production even if the buyer happens to be out of state (out of state might be better wording than Texas and Kansas since some are from other states as well). This whole sentence hints that the ranching industry in De Baca County is declining, which is not the case. De Baca County Assesors show that so far, in 2016, livestock values have increased by 21%.
8	30	6.2.1 paragraph 4	The first sentence states that the only opportunity for economic development is wind turbines. This again is not a factual statement. It is ***only one opportunity*** that is getting more focus because it is a recent trend, with transmission lines and towers going up in neighboring counties. Tests have been done in areas of De Baca County and the results have come back that De Baca County has some of the best wind for towers.
9	30, 31	6.2.1 paragraph 4	The second sentence states that residents are anti-growth. This is another unfactual statement. The county is actually in the process of writing a comprehensive plan with much of the discussion focused on economic development. It is a mis-representation in the following sentence to associate the dairy and a prison as a statement to prove that De Baca County is anti-growth. There are a lot of other factors that come into play such as the deal hinging on securing grant funds,obtaining land for the facility, and whether or not water is available, etc.
10	2	Bullet 2, Technical approach	This bullet states that projections of future demands in the nine categories are based on demographics and economic trends. Because of the many inacuracies described about De Baca County in section 6.2, how can the remainder of the document accuratley reflect the appropriate water use necessary for the county in the future? Nowhere in the document does it provide evidence of how the population projections in Table 6-3 where determined. Without this evidence how can any of the predictions be considered scientific or viable?
11	37	Bullet 1	This paragraph makes another reference to the declining population of De Baca County, and as stated on page 2, this reference is what water usage projections throughout the plan are based upon. You can not take water away from the agricultural sector based on these projections because the Village of Fort Sumner population declines at a faster rate than the county (U.S. Census). However, it should be noted that while De Baca County has been facing a popluation decline there has acutally been an increase in population in De Baca County's unicorporated areas by 9% (De Baca County Comprehensive Plan 2016)). This supports the data that reflects a 17% increase in number of farms and provides some evidence that the agricultural economy in De Baca County is not declining.
12	41	6.5.1 paragraph 2	Again another reference stating population as the determinant for water demand. Please refer to comments 10 and 11. This paragraph pretty much states that unless you show population growth you are out of luck. Please note again that in the case of De Baca County a decline in population does not correlate with a decline in the agricultural economy.
13	43, 44	paragraph 1 on both pages	It makes reference multiple times that information was gathered from interviews with individuals to be used as sources of information. I believe that these interviews were not conducted unbiased. The persons interviewed did not know their comments were being used to represent De Baca County in such a negative way. Using interviews as a method to develop projections is not factual as individual opinions may not be based upon factual information. This has been proven in previous comments referring to De Baca County.

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Comment Number	Page Number	Paragraph or Section Number	Comment
14	46	6.5.2 paragraph 4, 5: bullet 1	The paragraphs state that a decline in the agricultural sector will occur and there will be a drop in agricultural water use. Again make notice that citing an interview as a source of reference is not a factual reference. In fact, the number of farms in De Baca County have increased by 17%. An aging population in De Baca County does not correlate with a loss of farms or ranches. There is always agricultural land being sold to new buyers, and new families are moving onto those farms and ranches. Ranch and farm land is not significantly going out of production as stated in the plan. Nowhere in the plan has proof been provided that De Baca County's agricultural economy will decline. Not only has there been a 17% increase in the number of farms, but numbers from the De Baca County Assessors Office show an increase in livestock values and numbers in 2015.
15	47	5th bullet	This bullet reports a decrease in the water usage required for livestock. The last sentence states that ranching families will abandon this occupation. Again, another unfactual connotation being used to pigeonhole De Baca County's small size. Families that leave the occupation sell their ranch to another buyer and a new family moves onto the ranch to occupy it. There are no significant amounts of agriculture land lost. We do not expect to see a permanent loss in livestock production to justify such a decline in livestock water use. Livestock numbers have declined because of drought. Page 8 of this plan references 2011, 2012, and 2013 (being the worst) drought years. Records from the De Baca County Assessors office show that since 2013 livestock values have more than doubled and numbers have increased by almost 8,000 head, and projected to increase as more ranchers report numbers this year. The population high and low scenarios being used to project water usage give an inaccurate projection when compared to this data.
16	1	3	section 1 should be corrected to section 3
17	13	4.1.2.1	State Engineer Order 174 created the Lower Pecos River Basin Water Master District, containing sub-district basins (Fort Sumner, Carlsbad, Roswell Artesian, Hondo). The State Engineer ordered that a Water Master be appointed on a perminant basis and that the salary and expenses of the Water Master shall be paid monthly by the water right owners through the boards of commissioners of De Baca, Chaves, Eddy, Quay, Lincoln, and Otero Counties . It is a duty of this Lower Pecos Water Master to adminiser BOTH surface and groundwater and to supervise all other sub-district water masters. It does not appear that the OSE has modified its internal organization of water masters and has maintained the payment structure of old Pecos Water Master having only Pecos surface water users (mainly CID and FSID) to pay for this position.
18	15	4.1.2.5	A vast majority of Hondo Surface and groundwater is already adjudicated
19	18	4.1.5.4	VOR has completed a Conservation Plan and Water Development Plan and is awaiting review from the OSE; There is also a source water protection plan
20	1	5	section 1 should be corrected to section 5
21	2	5	last bullet, I think that District II is the only district that allows three separate temporary 72.12.1.3 permits per year/well
22	8	5.2	top of page, VOR has added a river pump at the conflunce of Carrizo Creek and Rio Ruidoso. (Doydan, 2015) should be (Boyda, 2015) and citations in back should be fixed
23	11	5.3.1.3	I am unsure of the purpose of pointing out that the Village of Ruidoso has 6 active wells in the Yeso Formation and volcanic rock
24	14	5.3.2	RA Basin doesn't indicate trends in water level like other basins
25	15	5.3.2	what is the definition of major well field? How does this relate back to aquifer conditions Why isn't this merged with previous section?
26	1	6	change 1 to 6 for section
27	4	6.2.2	Recommended changes to first 4 paragraphs"The primary economic driver for Lincoln County, generally, and the Village of Ruidoso and City of Ruidoso Downs, specifically, is tourism. The majority of tourists are from the State of Texas, however the number of visitors from Northern is growing. The Village of Ruidoso has seen double-digit growth in lodging revenues for the past two consecutive years. The Village's gross receipts are increasing, as well. Building activity in Ruidoso is slowly rebounding. Work on a 62-lot residential development is underway. Preliminary plans for two other residential developments are being reviewed. Commercial activity, as well, is improving. Several restaurants have undergone recent expansion. A large venue for special events is near completion. Village voters have approved an $18 million bond for the construction of a new municipal school campus. Construction will commence in 2016 with completion scheduled for 2018. The Village is preparing to commence a $36 million project to realign wastewater lines. Commercial activity, in the County, will benefit from planned construction of a new hospital (expected to be a $30 million + project), as well as potential school construction in Capitan. The management of water is a key issue within the County. The Village of Ruidoso has recently adopted a water conservation plan and established a water rights/conservation administrator. The Village has devoted considerable resources towards the reduction of leaked water, including completion of a relining of the Grindstone Dam, replacement of water lines and, most recently, commencement of a leak detection program."

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Comment Number	Page Number	Paragraph or Section Number	Comment
28	13	6.4	technology changes that have increased the consumptive use/acre of agriculture may be one of the biggest issues impacting LPV
29	15	6.5	Projections for domestic (self-supplied) for Lincoln county seems very low. If estimates are based upon census population, but there is a large amount of second home owners (that are not captured in census populations) then the value may not closely estimate use. Furthermore, higher income second home owners might use water differently than the rest of a population, potentially investing more in maintaining landscaping that requires irrigation which would skew the 80 and 100 GPCD used in Longworth 2013.
30		8	I feel that regionalization should be added to the program list and include infrastructure that supports regionalization as a project. This is supported by several County Comprehensive plans including: Eddy County WR Goal 3 “Prioritize the regionalization of water systems”; Lincoln County I Goal 2 Strategy 4 “Promote the development or extension of centralized wastewater services to areas of growth where population density is high”; and Chaves County Objective 9.1b “To ensure on adequate water supply for new residential or commercial development” Policy 9.1a “Chavez County shall support long-range regional water planning and pursue the implementation of the Lower Pecos Regional Water Plan with other jurisdictions and entities with a primary focus on protecting Pecos River water and keep it in the valley”
31		8	The 2003 State Water Plan points out that “New Mexico’s water infrastructure is aging, and in many areas of the state it is inadequate to meet current demand”. Furthermore, the plan outlines issues with increased Federal drinking standards are significantly driving up the costs of operating small community water systems. The 2013 State Water Plan Review further explains that “Small systems particularly struggle to implement adequate rate and management structures, access technical support and maintain qualified system operators to keep up with capital infrastructure development and asset management.
32		8	The 2013 State Water Plan review then points out that the House Joint Memorial 86 lead to the creation of the following criteria for expenditure of public funds improving investment on infrastructure development: A financial plan; an appropriate rate structure; an asset management plan; a water accounting system with full metering; full compliance with OSE regulatory requirements; full compliance with the Safe Drinking Water Act, the Clean Water Act, and NMED regulations; a legal and adequate governance structure; planning to support project development and operations; participation in collaboration of regional efforts toward long-term solutions; and an energy efficiency strategy.
33		8	Many small community water suppliers are unable or falling behind in complying with these criteria. The 2003 State Water Plan directs the State to prioritize and fund regionally significant projects, especially large infrastructure projects associated with development of new water supplies, Indian water rights settlements, and regional water and wastewater systems that improve services, operations, and economies of scale. By supporting regionalization efforts, small communities will have support in developing regional coops/partnerships to better meet the increasing demands being placed on them; be more capable of handling drought planning; and can invest cost savings in water conservation measures.
34		PPP table	This comment is in response to the discussions of the PVWUO at the April 8, 2016 regional water planning meeting concerning the Seven Rivers Well Field. I felt the consensus of the majority of the PVWUO members presents was that the Interstate Stream Commission should cease pumping of this well field. Discussions by the group pointed to the affects of the pumping of the Sever-River Well field has on other wells in the area. I feel this is an over-reach on the part of the Regional Water Planning to try and dictate the terms of settlement agreement currently in place between the United States Bureau of Reclamation, New Mexico State Engineer, New Mexico Interstate Stream Commission, Carlsbad Irrigation District, and Pecos Valley Artesian Conservancy District. The duties of the Regional Water Planning Committee should not extend to the interpretation and administration of state water rights
35	7	5	Well fields have proven to be ineffective in augmenting water supply especially during drought times and have significantly affected regional private wells indicated by the decline and/or drying up of these wells. New methods of delivery need to be reviewed and administered to comply with Compact and CID compliance.
36		6	I would like to know where you got some of your information especially for DeBaca County. We have lived here for 4 years and I find in reading the proposed Regional Water Plan to have several erroneous statements and information stated as factual when in truth, they are not correct. Please read this draft carefully, fix the mis-representations and be able to site your reliable sources (such as DeBaca County Assessors and/or USDA-NRCS) before adopting this proposal.
37		Table 3-1-a	I found 54,834 on the US census web page for 2013 not 55,471.
38		Table 3-1-c	De Baca county number of farms is not consistent with NASS , NASS had 203 farms not 154. Under Eddy did not include DOD- nuclear.
39		Table 3-1-d	Add ranking in state as far as agriculture production. Chaves- 1; Eddy 6; otero 11, Lincoln 13, De Baca 26 Census of agriculture is more accurate than NASS.
40		Table 5-8	TMDL table need to have the date of assessment on it.
41		Table 5-10	It is difficult to accept that Ruidoso village only discharges 1,333 gallon per day, when crona is 20,000.

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Comment Number	Page Number	Paragraph or Section Number	Comment
42		Table 6-1	Definition of categories - Livestock is insufficient. See NMSU publication http://aces.nmsu.edu/pubs/_b/B231.pdf http://aces.nmsu.edu/pubs/_circulars/CR670/welcome.html
43		Table 6-2	Projected populations it cites PVWUO when in the 2002 plan we were required by the ISC to us UNM school of Business to do projections. NMSU had projection that we felt were closer to what was going to happen and could not use them. See. *Population projections to 2010 for New Mexico counties by age, sex and ethnicity (Handbook / New Mexico State University, Cooperative Extension Service) Unknown Binding – 1994 by James T Peach (Author)*
44	1	Introduction, 3rd paragraph	Water planning in NM started far before 1987. PVWUO has maps for water planning from 1974, and narrative.
45		Section 3?	Why is it necessary to repeat what is in the 2002 plan when this is supplemental to it?
46	11	Section 5.1.2	The narrative page 11-12 talks about climate change; it does not address how climate change will affect the Texas NM Pecos river compact based on 1947 conditions.
47			NOTE: 2002 plan state we were 25,400 Acre Feet short in 2040. Currently NM oil and gas association state it is reinjection of 118,000 acre feet per year.
48			The whole economic narrative is full of inaccurate information and gaps that could have been identified by using the steering committee.
49		Section 6.2.1	6.2.1 is very incorrect. See De Baca county comments.
50		Section 6.2.2	6.2.2 I have not found in the USDA data base or census of Agriculture data base a definition for "recreational farmer".
51		Section 6.2.3	6.2.3 does not mention Lepreno cheese. Produce water or dependence on dairy and alfalfa hay.
52		Section 6.2.5	6.2.5 Does not mention Holly energy refinery or is disposal of produced water.
53			No mention of the Native American reservation in this planning region.
54			Does not mention that in 1993 Carlsbad basin put on water meters as well
55			No mention of produced water.
56		Table 6-5	Water use pie charts need to reflect environmental water. Losses to endangered species, to environment recharge page 46
57			Longworth data 2013 is questionable upon review. Especially Eddy County.
58			Please also see comments on the Technical Approach and Planning Process in the comment forms submitted by Woods Houghton

STATE OF NEW MEXICO

PECOS VALLEY WATER USERS ORGANIZATION

RESOLUTION 2016-1

RE: Lower Pecos Water Planning Process

Whereas:

The Pecos Valley Water Users Organization has been an active participant in regional water planning since before 1998, and has historic roots back to the 1880's and,

Whereas:

It is our understanding that the Interstate Stream Commission (ISC) and the Office of the State Engineer (OSE) saw the need to update regional water plans from 2001 and,

Whereas:

The ISC and OSE had limited funds appropriated from the New Mexico State Legislature to accomplish such an update and,

Whereas:

The ISC and OSE contracted for technical information to be compiled, analyzed, and published. The time line for completion of the project and review of the draft was insufficient for such a large undertaking and,

Whereas:

This technical information was not submitted for review by the regional water planning steering committee or for direction or assistance or for public review and comments until the draft was completed and,

Whereas:

There are numerous and obvious errors on the economy of many of the counties which are within the region. There are errors concerning Agriculture, in that Agriculture is not treated as a base industry, as the U. S. Department of Home Land Security has designated. The economic impact of agriculture is not addressed as other base line industries are in the technical portion of the proposed revision of the regional water plan. The livestock water use section is completely and totally inaccurate and insufficient and,

Whereas:

Agriculture is the majority water right holder in the region, and the misrepresentation in the technical portion is so grievous as to cause economic harm to rural communities and counties.

THEREFORE BE IT RESOLVED THAT WE, the members of the Pecos Valley Water Users Organization do respectfully request that the technical section be reviewed and corrected by an Agriculture Economist and /or Rural Development Specialist who knows the economy of rural New Mexico such as the Agriculture Economic Department of New Mexico State University in cooperation with the Range Improvement Task Force, The Natural Resource Conservation Service and Farm Service Agencies and,

BE IT FURTHER RESOLVED:

That this review will be accomplished with the members of the Pecos Valley Water Users Organization in full public transparency.

APPROVED AND ADOPTED this 10 day of June, 2016

Woods E. Houghton, Chairman, Representing all of those who were in attendance at the 10 June 2016 meeting of the Pecos Valley Water Users Organization, roll call vote on record.

STATE OF NEW MEXICO)

County of Eddy)

The foregoing instrument was acknowledged before me this 10th day of June, 2016 by Woods E Houghton of the Pecos Valley Water Users Organization.

Notary Public

My commission expires Oct. 10, 2016.

OFFICIAL SEAL
Robin Kincaid
NOTARY PUBLIC
STATE OF NEW MEXICO
My Commission Expires: Oct 10, 2016

Appendix 6-A

List of Individuals Interviewed

Appendix 6-A. List of Individuals Interviewed
Lower Pecos Valley Water Planning Region

Name	Title	Organization	City
Hubert Quintana	Executive Director	Southeastern NM Economic Development District	Roswell
Cindy King	President	DeBaca County Chamber of Commerce	Ft. Sumner
Alan Sparks	Executive Director	Ft. Sumner Community Development Corp.	Ft. Sumner
Stanton Riggs	County Manager	Chaves County	Roswell
John Mulcahy	President, CEO	Chaves County Economic Development Corp.	Roswell
Brad Davis	Realtor	Prudential Enchanted Lands Realty	Roswell
Jeremy Kohler	Branch Manager	Farm Credit of New Mexico	Roswell
Brett Donaldson	Executive Vice President	Pioneer Bank	Roswell
Marlin Johnson	Planning and Zoning Director	City of Roswell	Roswell
Larry Fry	City Manager	City of Roswell	Roswell
Zack Ponce	Reporter	Current-Argus	Carlsbad
Candace Lewis	Office Manager	Roswell Chamber of Commerce	Roswell
Louis Gallegos	Public Works Director	Village of Ft. Sumner	Ft. Sumner
Jeanne Kelley	Director of Tourism	Ruidoso Valley Chamber of Commerce	Ruidoso
Bobbye Rose	Community Development Director	Village of Ruidoso	Ruidoso
Steve Dunigan	Planning Director	Village of Ruidoso Downs	Ruidoso Downs
James Russ	Realtor	Connect Realty	Ruidoso
Curt Temple	Planning Director	Lincoln County	Ruidoso
Debi Lee	City Manager	Village of Ruidoso	Ruidoso
Kay Strickland	Village Clerk	Capitan	Capitan
Nathan Thomas	Mortgage Broker/Rancher	Ruidoso Mortgage	Ruidoso
George Bickert	Superintendent	Ruidoso School District	Ruidoso
David Wieber	Banker	City Bank of New Mexico	Ruidoso
Rob Turner	Loan Officer	First National Bank	Ruidoso
Steve McCutcheon	City Administrator	City of Carlsbad	Carlsbad

Appendix 6-A. List of Individuals Interviewed
Lower Pecos Valley Water Planning Region

Name	Title	Organization	City
John Waters	Executive Director	Carlsbad Department of Development	Carlsbad
Robert Defer	President	Carlsbad Chamber of Commerce	Carlsbad
Jay Jenkins	President & CEO	Carlsbad National Bank	Carlsbad
George Dunnigan	Realtor	Dunnigan Realty	Carlsbad
Philip Carter	District Conservationist	USDA - NRCS	Lovington
D'Llayne Bruce	District Conservationist	USDA - NRCS	Ft. Sumner
Michael Bunt	Economic Development Director	Artesia Chamber of Commerce	Artesia
Phillip Burch	Mayor	City of Artesia	Artesia
Jackie Powell	County Commissioner	Lincoln County	Carrizozo
Nita Taylor	County Manager	Lincoln County	Carrizozo
Curt Temple	Planning Director	Lincoln County	Ruidoso
Steve Dutill	GIS Supervisor	Otero County	Alamogordo
Bill Duemling	Engineer Specialist Supervisor	OSE District II	Roswell
Josephine Lucero	De Baca County Assessor	De Baca County Assessor's Office	Ft. Sumner
Jerry Hawkes	Agricultural economist	New Mexico State University	Las Cruces

Appendix 6-B

Projected Population Growth Rates, 2010 to 2040

Appendix 6-B. BBER Projected Five-Year Population Growth Rates, 2010 to 2040 Lower Pecos Valley Water Planning Region

County	Five-Year Growth Rate (%)					
	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040
Chaves	4.19	4.51	4.52	4.12	3.56	3.15
DeBaca	-1.73	-1.86	-2.10	-1.57	-2.08	-2.01
Eddy	3.72	3.72	3.52	3.15	2.84	2.61
Lincoln	NA	NA	NA	NA	NA	NA
Otero	NA	NA	NA	NA	NA	NA

Source: New Mexico County Population Projections, July 1, 2010 to July 1, 2040.
Geospatial and Population Studies Group, Bureau of Business & Economic Research,
University of New Mexico. Released November 2012.

NA = Population growth estimated for entire counties only.

Appendix 6-C

Lower Pecos Valley Livestock Water Use

Livestock Daily Water Consumption Requirements

By Woods Houghton (Eddy County Extension Agent), Darrell Brown (Operator 4 Dinkus Ranch), and Don Alum (retired NRCS District Conservationist).

Water consumption by livestock on a New Mexico ranch has historically and traditionally included several different classes of beef cattle, horses, mules and donkeys and sheep and goats. There is also a variety of wildlife species living on the ranch. In order to have a continuous and reliable supply of water to meet the peak demands for water consumption on any given day at any given location, the storage of water, in both fabricated (steel and fiberglass) storage tanks and dirt pit tanks, is necessary. However, there are water losses due to evaporation from tanks and troughs and through leakage and friction as it is distributed through miles of water pipeline. These values must also be included when calculating beneficial use as a cost of meeting the daily demands. The impacts of long-term drought, which has plagued New Mexico ranches for the last quarter century, must also be considered, especially in the area of impounded surface water.

Most of the research performed to determine or predict daily water consumption has been conducted in small traps, paddocks, or pastures that can be easily monitored. Data collected was primarily at universities and research stations located in areas that achieve much higher levels of relative humidity than found in New Mexico. Additionally, many of the experiments were conducted during warm-season months while the test areas were producing forage with high moisture content. The average relative humidity in most of New Mexico rarely exceeds 30% (often it is below 10%) and the growing season for range grasses may be as short as 3 weeks. Research conducted in Arkansas, Iowa, Oklahoma, Texas and Nebraska does not directly correlate to New Mexico's desert conditions.

Ultimately, the allocation of water for a given Ranch must be based upon determining what qualifies as "a reliable source and supply of water" and what amount of water is used by the ranch to economically operate and function on a daily basis while meeting the above parameters. At present, the parameters of determining this value seem to be based solely upon the daily water consumption of the cow herd. This is not how water rights have legally or traditionally been determined in adjudication proceedings for a given water basin. An attempt will be made to quantify the total usage.

Biological Requirements

When considering the daily consumptive needs of free-ranging beef cattle, it is necessary to have an elementary understanding in the fields of biology, anatomy and physiology, animal husbandry and range management as well as agricultural economics. Some understanding of "cow psychology and philosophy" (topics which are not taught in most schools and universities), also prove useful in understanding how frequently cows drink, the biological and sociological impacts of limited or "dirty" water supplies, the distances traveled for a drink, etc.

When considering water requirements from the biological and physiological perspective, all ruminants (which would include antelope, deer and elk as well as beef cattle) need water daily for many bodily functions. These would include such items as the digestion process, elimination of waste (feces of healthy cattle often contain 75 to 85 per cent water), blood flow and proper blood pressure, the production of milk and saliva, temperature regulation and many other functions.

> Water is the most abundant constituent of the body fluids, accounting for 60 to 70 percent of the total livestock body weight. Functions of water within the body include being solvent for chemicals and maintaining cell osmotic pressure. The physical characteristics of water such as relatively high specific heat and the dipolarity of the water molecule make it ideal as a body temperature regulator and transport medium. Because of the high importance to metabolic functions, failure to provide enough water will reduce animal performance more quickly and severely than any other nutrient. Access to sufficient quantities of clean water will result in increased dry matter, or DM, intake and thus increased animal performance. Some studies suggested a reduction in nutrient digestibility if water is limited to cattle. Other negative effects may include decreased rates of respiration and rumination and increased concentrations of urea and potassium in blood serum. Several authors have suggested that a low drinking water temperature may be more beneficial for animal temperature regulation than large quantities alone. (1)
>
> Water consumption requirements depend on a number of factors including:
>
> - size of animal
> - air temperature and relative humidity
> - rate and composition of gain
> - level of dry matter intake
> - moisture content of the ration
> - pregnancy
> - lactation
> - level of activity
> - access to shade
> - distance to water (2) (4)

Digestion

"Metabolic water" (water supplied through moisture in the feed) is in very short supply in the wind- and sun-cured range grasses of most of New Mexico's ranches (3). With the higher "dry matter" content of these range grasses, even more water will need to be consumed for digestion and utilization of the nutritional components. Without proper hydration, livestock simply cannot fully maximize the grazing potential of the land. They will literally reduce grazing times thus cutting their consumption of forage products (4).

> Water is obviously essential to the survival and health of your cattle herd. But it is also essential to cattle weight gains. Survival only requires a minimal amount of water, but to maximize pasture gains when raising beef cattle you need to ensure that your cattle have enough water to be able to digest all the grass they can eat.
>
> Even if the livestock waterer is capable of meeting your herd's daily cattle water requirements, if peak demand is not met, your cattle will shorten grazing times and spend most of the day mobbing the water trough. If flow rates at the trough are insufficient to meet peak demand, dominant cattle will try to block other cattle from accessing the trough, which increases stress in the herd and reduces the amount of water each cow or steer will drink in a day. This translates into reduced grazing time and reduced cattle weight gains. (4)

Dr. Dirk Philipp, Assistant Professor in Animal Science at the University of Arkansas, suggests a conservative estimate is to provide 1 gallon of water per pound of DM consumed.

Environmental Factors

Fluctuations in air temperature are equally accountable for differences in daily water intake. Just as with humans, water consumption typically increases during summer months and decreases in the winter. However, water consumption in winter months is very necessary to ruminants for digestion but is also of great importance in body heat regulation. In northern climates, where air temperatures struggle to achieve 32 degrees Fahrenheit during winter months, it is often prudent to provide heated water to insure that enough water is consumed to meet the needs of cattle in that environment. Table 1 provides an overview of quantities recommended during hot days in comparison with cool days.

Table 1: General watering needs for various classes of livestock depending on air temperature (6).

Livestock Type	Water needs per animal (50° F day)	Water needs per animal (90° F day)
Dry Beef Cows	8-12 gallons	20-30 gallons
Lactating Beef Cows	12-20 gallons	25-35 gallons
Lactating Dairy Cows	20-30 gallons	30-40 gallons
600-lb Weaned Calves	6-9 gallons	10-15 gallons
Horses	8-12 gallons	20-25 gallons
Sheep and goats	2-3 gallons	3-4 gallons

Livestock drinking water when the air temperature is 50 degrees Fahrenheit or less normally will only drink once per day. When temperatures increase, it is not unusual to observe cattle drinking multiple times during the day. In a study conducted on the Jornada Experimental Range in south-central New Mexico between May 23 and July 16, 1986, 94% of the cows were satisfied with one drinking event per day. The other 6% of cows drank 2 or even 3 times per day. In 507 observations, 77% of the cattle drank for 2-4 minutes, consuming between 4 and 7½ gallons of water per minute. (7)

Different water requirements under different conditions reflect the need of the animal to maintain water balance within the body. Approximately 20 percent of the body weight is considered extra-cellular water from which emergency water can be drawn to avoid dehydration. Mature animals have about 10 times more reserve water available than calves; therefore, young animals are much more sensitive to distress from diarrhea than older animals. Water requirement can vary widely based on the current condition of the animal or goals of production. (1)

Pregnancy and Calves

When considering the beneficial use of water from the perspective of maximizing production on a ranch, one must understand the 4 nutritional stages in the production of beef cattle under range conditions. They are **maintenance, gestation, lactation, and growth**. Within any 12-month span of time, all productive females in the herd will be subject to the nutritional requirements in all four categories. All classes of cattle are subject to both maintenance and growth requirements. The first nutritional requirement that cattle (or any form of wildlife) must meet is survival and maintenance functions of their bodies. Depending upon body weight and body condition score, a maintenance diet may meet all that is required of them during a particular stage of production.

However, for brood cows to conceive and remain pregnant for 285 days, they need to be on an increasing plane of weight gain which requires additional nutrition and additional water for digestion. Similarly, cows that are lactating need additional nutrition, especially water for the production of milk.

The growth stage may occur in calves and yearling cattle but also occurs in mature cows and bulls that are renewing body tissues that may have been spent in an effort to compensate for lower nutrition levels earlier or from increases in body activity (i.e. pregnancy, lactation, breeding season, etc.). There are also environmental impacts such as temperature, humidity, plant availability and stage of growth, etc. that affect daily water consumption.

Based upon research conducted at a number of universities, a maintenance level ration for cattle is approximately 2% of body weight. Therefore, a cow weighing 1,000 pounds would require 20 pounds of "feedstuff" per day. According to Dr. Philipp (and his conservative estimate of providing 1 gallon of water per pound of DM consumed), that 1,000 pound cow would require 20 gallons of water per day. However, this is based upon animals that are hand-fed in research pens or at best very small paddocks). Cattle grazing on western ranges will require additional amounts of nutrition from the forage they travel to gather and thereby additional water.

Another way of estimating daily water consumption is calculated based upon percent of body weight. In a release by Oklahoma State University Extension on June 29, 2012:

> Daily water needs of non-lactating animals will run from 0.75 to 1.5 gallons per 100 pounds of body weight or 6-12% of their body weight. Lactating cows may consume 18% of their body weight in water. A 1,200 pound spring calving cow will require about 216 pounds of water on a hot summer day (not counting calf consumption). A gallon of water will weigh roughly 8 pounds, this equates to 27 gallons of water per cow per day. Water intake is dependent on climate, feed type, production stage and salt intake. Water is important. Decreased intake affects health, production and growth. (5)

Distance to Water

> How often will a cow come to water? The same factors that influence how much she drinks also influence how often she will drink. According to Gerrish and Davis (1999), beef cows may travel to water three to five times per day. They travel less often but stay longer if they have to go a long distance.

> How much water can a cow drink at one time? Normally she will drink about two gallons in a one to three-minute period and, again, the amount and duration increase if the animal travels far.
>
> How much water should be supplied for a herd and where should the water be located relative to the size and shape of the pasture? It is best to supply water in each pasture and not force cattle to travel a great distance down a lane or over rough terrain to obtain it. A recent study by Gerrish and Davis (1999) revealed that if cattle had to travel over 700 to 900 feet to obtain water, they foraged quite inefficiently. (7)

Cattle, in order to maximize production, should never have to graze or travel more than ½ mile to water, regardless of the size of the pasture. When cattle "go for a drink," they do not proceed in an orderly manner; a few at a time. Instead, they tend to gather at water "all at one time" or at least in large groups. In order to provide for the total daily needs of the cattle in any given pasture, it is necessary to insure that adequate supplies of water and trough space are available. This requires planning and installation of drinking facilities that provide for the maximum numbers of cattle that might drink at one time.

> Providing livestock easy access to a reliable source of clean, fresh water at all times is necessary in order for a livestock operation to be productive. NRCS has several stockwater system practices that are designed to efficiently provide reliable water to livestock and wildlife and successfully allow for the implementation of a grazing management system. The benefits of supplying adequate watering facilities for livestock can be: improved livestock distribution to take advantage of available forage in remote areas, improved livestock health and production and providing for an improvement in vegetation and soil conditions in uplands and streams, rivers and ponds.
>
> One important factor to consider when installing a new water source is the distance livestock have to travel to drink. Water needs to be delivered to the areas where livestock are grazing or where it is desirable to have the livestock located, rather than requiring livestock to travel long distances to drink. Requiring livestock to travel too far can result in animal stress and reduced productivity. In some instances the water source, such as a well or spring, is not always the best location for livestock to drink. A stockwater system may need to provide water to multiple locations by use of a pipeline and troughs in order to cut down on livestock travel. Livestock water locations need to be closer to grazing areas in steep, rough terrain, whereas, livestock can travel longer distances without exerting as much energy in relatively flat country.

A successful stockman and good range manager will consider the topography and terrain, varying range conditions, vegetation types and grazing patterns of the cattle within the pasture when determining proper stocking rates and the number and locations of watering facilities needed for the most advantageous distribution of water. While cattle on a New Mexico Ranch are normally scattered across the ranch, there are certain pastures during the year that are, for a period of a few weeks, utilized by a large percentage of the entire cow inventory. These are typically the smaller pastures and traps used for gathering the cattle for branding, weaning, or shipping. During these high-stress events, it is even more critical to insure maximum storage and distribution for the well-being of the cattle.

Location of watering facilities on grazing lands has been widely recognized as a factor controlling grazing distribution by ruminants. In rangeland environments, the typical recommendations are that animals travel no farther than 2 miles to water on flat topography and no more than 1 mile in rough country (Smith, et al, 1986). In humid temperate environments less attention has been paid to water location and its effects on grazing distribution. Over several years we had visually noted that differences in grazing distribution occurred even in relatively small pastures and seemed to be oriented around water location.

The objective of this research was to determine how distance beef cows must travel to water affected grazing distribution and pasture utilization rate. As with most biological research, more than one parameter affects the final outcome. Stock density, topography, plant community will all affect grazing distribution. In this project stock density and total acreage in each paddock were held constant. Given this fact, distance from water necessarily became confounded with shape of paddock. That is a ten acre paddock with a maximum distance to water of 700 ft must be nearly square while a paddock with a maximum distance of 1400 ft to water cannot be square but must be rectangular with given dimensions.

It is important to understand that grazing distribution across the landscape is influenced by a number of factors. These include topography, plant community, length: width ratio of the paddock, and stock density as well as distance travelled to water. In the rolling landscape typical of north Missouri, topographical location of the watering site will have an impact on grazing distribution in and of itself. As the pastures used in this project had been grazed in the same configuration for the 10 years preceding this study, pre-existing gradients in soil fertility and plant community were likely to exist. The type of relationships discussed in this paper must be considered in the context of the time continuum. (8)

Water Quality

The quality of the water is also an important factor that needs to be considered. Livestock will be less likely to drink adequate quantities of poor quality water due to contamination or poor taste and can become stressed which ultimately affects production. (8)

The drought of 1998 forced many grazers to consider available water supplies. A water deficiency reduces animal performance, such as milk production, more quickly and severely than feed or mineral deficiency. Both quantity and quality of water are important.

Many old ponds that were shallow and full of sediment failed to supply good-quality water. The diminished water level provided an opportunity to clean ponds and create a more permanent and desirable water supply.

Shallow ponds are inadequate because water quality deteriorates faster, particularly if livestock are allowed to enter the ponds on a daily basis. The animals stir the sediment and defecate and urinate in the pond. A real danger exists in July and August if a pond exhibits a bloom of blue-green algae, which flourish in stagnant water where there has been runoff from animal waste; the algae can be toxic if ingested by wildlife, livestock or people. (7)

Evaporative Losses

Most of the storage tanks on a ranch are located at water wells or along pipelines. They measure approximately 30 feet in diameter and are between 5 and 6 feet in depth. Many of the older ones have drinking troughs connected and all storages have drinking troughs very close by. The older tanks are constructed from steel but many have been modified and repaired using cement or fiberglass. Approximately 30% of all the drinking troughs are constructed with fiberglass that have been installed in the past 20 years to replace metal troughs that had rusted out or to provide additional waterers in the pasture if a pipeline is present. The water provided through this system of delivery would be considered reliable regardless of environmental factors and for purposes of definitions in this report are referred to as “permanent sources.”

Any water stored, whether in steel or fiberglass storage vessels or dirt pit tanks, is subject to evaporation. Pan evaporation is a measurement that combines or integrates the effects of several climate elements: temperature, humidity, rain fall, drought dispersion, solar radiation, and wind. Evaporation is greatest on hot, windy, dry, sunny days; and is greatly reduced when clouds block the sun and when air is cool, calm, and humid. (9)

There are many stations around New Mexico that record pan evaporation rates and these are reported by Western Regional Climate Center, see Table 2. The pan evaporation rate at the Artesia Plant Science Center, NMSU, is about 88 inches per year long-term average.

Table 2: Evaporative losses observed at stations in south-eastern New Mexico.

Observation Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Artesia 1914-2005	4.38	3.03	7.25	7.66	12.11	13.13	10.86	10.44	9.36	6.34	3.12	0	87.68
Bitter Lakes WL Refuge 1950-2005	2.67	3.93	6.82	9.6	11.31	12.62	11.88	10.16	8.02	5.85	3.53	2.50	88.89
Brantley Dam 1987-2005	4.65	0	8.62	11.77	14.61	15.46	14.19	12.22	9.88	7.97	5.77	4.34	109.48
Roswell WSO Airport 1893-2005	0	0	0	11.29	0	15.87	12.11	12.63	7.92	6.97	4.66	4.51	75.96
Sumner Lake 1921-2005	0	0	7.33	10.22	12.35	13.54	13.36	11.16	9.02	6.97	4.92	3.17	92.04

Leakage

Although every effort is made to prevent losses due to leakage, there is a percentage of water lost from holes in tanks, troughs, and pipelines. There is also a loss of efficiency between the wellhead of any well connected to a pipeline and the final distribution point of the water traveling through the pipeline.

Dirt drinking troughs may also be located near wells pumped by windmills to collect any overflow from the storage tanks. The clay content in most of the soils on a ranch is relatively high allowing for little or no loss due to seepage from these troughs. Other ranches may have sands and require sealed soil tank, often pre-1990 was done with manure and post 1990 was done with bentonite clay or plastic liner. Other sources of water available are from pit tanks dug to divert water from arroyos and water flows following rain storms. Depending on the size of the rain event, the length and breadth of the water way and the surface area and depth of these pit tanks, water diverted into them could supply cattle with water for a day, a week, perhaps as much as 4-5 months. Very few pit tanks have the size and structure to impound water any longer; especially considering the severe drought conditions a South eastern ranch has experienced for much of the past quarter century. Since water impounded by rainfall is not subject to the control of ranch management, this water cannot be relied upon on a daily basis.

Equine Water Use

Horses present on the ranch are considered as tools rather revenue producing animals. Even though they are not ruminants like most other animal life on the ranch, they still share many of the same requirements biologically and physiologically.

The amount of water a horse requires can vary depending upon several factors (Referenced from: TheHorse.com June 2012):

The feed consumed can determine the amount of water required:

- Fresh pasture has between 60-80% moisture and can provide a large amount of the horse's water requirements when grazing.
- Hay and grain are very low in moisture, causing horses to drink more water.
- Higher levels of protein and sodium in the diet also increase the horse's water requirement as urinary volume increases.

Ambient temperatures above 85°F will increase a horse's drinking frequency and volume. Colder temperatures (below 45°F) can reduce a horse's water consumption. (10)

Calculating Beneficial Use Allocation

Concerning the issue of determining the beneficial use allocation of both surface and subsurface waters on a New Mexico ranch, it has become incumbent upon the owners and management of the ranch to both quantify and prove the annual “water consumption” of the ranch. At present, the parameters of determining this value seem to be based solely upon the daily water consumption of the cow herd. This is not how water rights have legally or traditionally been determined in adjudication proceedings for a given water basin. An attempt will be made to quantify the total usage. However, in order to obtain the correct total allocation for the ranch, other values must be added into the equation. The New Mexico Constitution Article XVI Sec.3 States that the *Beneficial use shall be the basis, the measure and the limit of the right to use of water.* Case law in New Mexico has stated that the beneficial use includes losses which occur in the conveyance and storage of water for beneficial use as long as it is not determined to be wasteful. State ex rel. Erickson v. Mclean, N.M. 264, 308 P.2d 983 (1957). Beneficial use should not be confused with consumptive use. Consumptive use refers to the amount of water actually consumed, i.e. not returned to the stream or aquifer. Rather Duty of water: the measure of the right to appropriate water is based upon the duty of water. That is the amount needed in particular circumstance with regard to soil conditions, methods of conveyance, topography and climate. State ex rel. Reynolds v. Mears, 86 N. M. 510, 525 P.2d 870 (1974). This was applied to irrigated agriculture; however, as shown in this document, conveyance, topography, and climate should also be applied to livestock production use of water.

Conclusions

The determination of daily water consumption on the ranch must be based upon all components of water use and transfer. Perhaps in equation form, it might formulate as follows:

Daily water consumption is equal to:

1. Consumption by the cattle (25-60 gallons per cow/calf unit per day) plus
2. Consumption by wildlife on daily basis (1.75 elk = 3.5 deer =1 cow) plus
3. Consumption by horses (10-25 gallons per horse per day) plus
4. Consumption by families plus
5. Evaporation and leakage losses

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Appendix 8-A

Recommended Projects, Programs, and Policies

Regional Water Planning Update

Projects, Programs, and Policies

Water Planning Region 10: Lower Pecos Valley

Planning Region	County	Regional or System Specific (R), (SS)	Strategy Type (Project, Program or Policy)	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead	Project Partners	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Policy	Improve System Efficiency	Policy Recommendations	**Enhanced Water Market**	Alternative 01 from 2001 plan (pg 231)	Alternative 1a is for action to enhance operation of the water-rights market by creating explicit administrative criteria and standard models by which all interested parties can evaluate the effect and costs of transferring water to new projects. Water-rights markets have been shown to function well in allocating water to more economically productive uses in New Mexico. A water-rights market automatically equates demand to supply. Another important element in a priority water market is a secondary market for leasing in which unused water from one water right holder can be leased to another water user. Monitoring and metering of the system becomes an important requirement to prevent impairment to other users. Most water-market transfers do not move water from the agricultural to the nonagricultural sector. A study of applications to the OSE to change the place or purpose of use showed that 29 percent of transfers were from agriculture to non-agriculture, while 38 percent were from non-agriculture to non-agriculture. Another 26 percent of transfers were between agricultural water uses.							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Policy	Protect Existing Supply	Increase Water Supply	**Managed Well Field Operations**	Alternative 02 from 2001 Plan (pg 236)	The 2001 alternative describes a process by which new (or existing) wells could be used to pump groundwater to the river to aid meeting CID and Compact deliveries. This was implemented with the construction of the Seven Rivers Well Field in 2005, which pumps groundwater south of Artesia into the Pecos River at Brantley Lake. The steering committee realizes that any modifications to this well field would require agreement from all parties in the Compact, but the regional concerns about the impact of the pumping are so strong that the steering committee would support ceasing operation of the well field until more studies can be conducted. This alternative was developed when water table levels were higher. This alternative also envisioned periods of aquifer recharge during wet times to compensate for the groundwater storage. The climate has been quite drier, however, over the last decade and it is feared that impacts from this well field have been greater than anticipated. The region would like to see this alternative updated to include more research (coupled with well disseminated results) on the impacts of this well field on: water table elevation, water quality, and ecological impacts of retiring water rights. These studies should also consider pumping strategies to minimize impact.	NM ISC / OSE		Predevelopment monitoring began in 2004 and well field operations continue today			Ensure Pecos River Compact delivery obligations during times of shortage	A monthly monitoring program of the groundwater elevation and water quality in the area was begun by the ISC in 2004, before the well field was drilled, and continues to this day. The groundwater elevation data is available on the ISC website. Perhaps this data could be made more accessible than the spreadsheets of data currently available (i.e. annual reports showing trends over time). Was the hydraulic impact of the K/M fault properly considered when the Seven Rivers Well Field was created? Has this well field been operated in compliance with the 2003 Settlement Agreement?

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Water Planning Region 10: Lower Pecos Valley

Planning Region	County	Regional or System Specific (R), (SS)	Strategy Type (Project, Program or Policy)	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead	Project Partners	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Protect Existing Supply	Water Conservation	**Agricultural, Municipal, and Industrial Water Conservation**	Alternatives 03, 05, 06 from 2001 plan	**Agriculture:** Efficiency is a big player in agricultural conservation. As irrigation methods become more efficient the farmer typically has more water to use and does not result in a direct savings to the overall water system. Drip irrigation is particularly difficult with hard, salty water. Low water use crops do not have a large market. **Municipal:** Several ideas were discussed, such as, metering domestic wells, reusing wastewater, public education on water conservation at the home, incentives for converting to low-flow and other water saving measures. Encouraging water conservation as part of all 40 year planning documents, encourage leak detection surveys and water audits. **Industrial:** Produced water in the oil gas field is a fast growing concern for this region. Finds methods to more beneficially reuse this produced water for other needs in the region should be highly considered.							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Policy	Improve System Efficiency	Reduce Evaporation Losses	**Moving Reservoir Storage**	Alternative 04 from 2001 plan (pg 244)	This alternative was intended to give CID flexibility in water storage (adjust entitlement storage to allow more storage upstream), however due to the regulations on compact delivery and where water can be stored, this didn't happen. This would be a good alternative to either revise or remove. There are plans by the City of Santa Rosa, US Fish and Wildlife, and the Bureau of Reclamation to create a fish pool at Santa Rosa reservoir (there is no minimum pool requirement at this reservoir right now). This plan needs to be reviewed for the new regional water plan.							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Protect Existing Supply	Environmental Protection	**Riparian Vegetation Management**	Alternative 07 from 2001 plan (pg 253)	Riparian vegetation management was one of the assumptions by the Joint Pecos River Investigation of 1942. The compact state's that water salvaged in New Mexico by reason of construction and operation of federal projects or by joint projects of the two states would be apportioned 57% New Mexico and 43% Texas; other waters recovered from non-beneficial consumption in New Mexico belonged to New Mexico so long as it did not diminish the quantity to Texas under 1947 conditions. A number of projects have been implemented in New Mexico, but an unprecedented drought followed these projects and water yield was undetermined at this time. It should be clear that this alternative does not create new water sources, but reduces non-beneficial diversions of the resource.						This alternative has become even more important as land has been retired from agriculture in the region. Weed populations are out of control on the fallowed lands.	There needs to be more concrete plans/policies for land management after water rights are retired from formerly active farm lands. Active land management of these lands is needed, including replanting with native or low water use species. The full consequences of the salt cedar beetle are worrisome and unknown.
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Protect Existing Supply	Environmental Protection	**Watershed restoration and watershed management**	Alternative 08 from the 2001 plan (pg 255)	Watershed restoration and watershed management is the planned manipulation of one or more hydrologic factors for the drainage area so as to affect a desired change in or maintain a desired condition of the water resources. Because the Compact is based on 1947 conditions, every effort to maintain the upper watershed to 1947 conditions should be an objective.	Land Owner/Manager, NRCS, Forest Service, BLM, State, Cities, SWC, Mescalero						

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Planning Region	County	Regional or System Specific (R), (SS)	Strategy Type (Project, Program or Policy)	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead	Project Partners	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Protect Existing Supply	Environmental Protection	**Dewatering of McMilan Delta**	Alternative 09 from the 2001 Plan (pg 257)	McMillan Delta, from Artesia to Brantley Lake, is the former site of McMillan Lake, an irrigation supply reservoir that silted up. McMillan Dam was breached in 1991. Shallow groundwater in the delta hydraulically connected to the Pecos River supports about 12,000 acres of salt cedar that consume up to 24,000 AFY. As a consequence, losses along the mainstem are high in this reach. Additionally, the Kaiser channel's present location tens of feet above the natural streambed contributes to transmission losses. The BOR's McMillan Delta Project, authorized in 1958 but never constructed, sought to salvage 24,500 AFY. The project was to consist of a channel heading structure, a salvage channel, a levee, and a cleared floodway. In this alternative , construction of a series of drains or wells coupled with vegetation management would lower the water table and reduce the area of salt cedar infestation. Returning the river to its topographic low channel would reduce streambed leakage. The recovered water would be stored in downstream reservoirs for irrigation, municipal, or Compact delivery uses or exchanged for upstream uses. Tributary flow from the Rio Peñasco would be channelized.							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Project	Increase Water Supply	Increase Water Supply	**Desalination**	Alternative 10 from 2001 plan (pg 259)	This is still an important alternative for this region, with active desalination starting in the region in the 1960's at Malaga Bend. An initial study by the Bureau of Reclamation was the first salt removal project of it's kind, attempting to decrease Pecos River salinity by decreasing the inflow of brine aquifer water into the river. By the mid-1970's the project ended due to concerns over leakage at the disposal reservoir. An attempt was made in 1992 to pump the water and sell the salt, but the project ended a year later due to concerns that the pond was hazardous to waterfowl and needed to be re-engineered. In 2010 the Pecos River Water Quality Coalition Formed to coordinate efforts of PRC, lawmakers, stakeholders and Federal and State Agencies. In 2012 there was a Pecos Initial Assessment by US Army Corps of Engineers and the USGS. In 2013-14 the Pecos Watershed Assessment Project was conducted as part of the Rio Grande Salinity Management Program. Sponsors for the Pecos Watershed Assessment Project included Texas TCEQ, New Mexico ISC, Texas Water Development Board. In 2013 the Southwest Salt Company began pumping brine water at Malaga Bend for salt harvest and by 2015 were producing 72,000 tons of salt per year. They plan to increase to 90,000 tons per year in 2016. They could produce 250,000 tons per year but would require 8 solar ponds and the NMED permit currently only allows 4 ponds There is a new study to generate electric energy using solar salt-gradient ponds at Malaga Bend.	The Bureau of Reclamation was the project lead for both studies mentioned	US Geological Survey and Pecos River Commission					Pecos River salt springs contribute up to ~172,000 tons o salt per year and have a salinity up to 4,100 ppm (Miyamoto & others (2007)). Information taken from http://pecosbasin.tamu.edu/media/453325/malaga-bend-ppt_prc-meeting_april-2014.pdf

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Water Planning Region 10: Lower Pecos Valley

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Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Project	Increase Water Supply	Increase Water Supply	**Interstate Pipeline**	Alternative 11 from 2001 plan (pg 262)	The importation of water into eastern New Mexico (as well as West Texas) was the subject of a Bureau of Reclamation Study released in May 1968.137 Several sources for the water were reviewed and evaluated, including the Columbia, Colorado, Missouri and Arkansas River Basins, some Canadian water systems, some Texas water basins, and the Lower Mississippi River. The conclusion made at that time was that the Lower Mississippi River was the only viable option, principally because the other basins did not anticipate having much excess water.							The steering committee would like to have this alternative removed, it is not feasible.
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Increase Water Supply	Increase Water Supply	**Cloud Seeding**	Alternative 12 from 2001 plan (pg 264)	Remove this alternative							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Project	Improve System Efficiency	Reduce losses	**Construct Additional Reservoirs**	Alternative 13 from 2001 plan (pg 269)	The idea behind the suggestion of a new reservoir or series of reservoirs is that sufficient rainfall may occur within the Pecos River watershed such that the existing reservoirs would overflow. If about half of this water (because of the Compact) could be saved over periods of several years, a net gain could be realized. However, no spillage of water has occurred in recent times.							The group was not hopeful that this alternative had much potential moving forward.
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Project	Protect Existing Supply	Aquifer Storage	**Aquifer Storage and Recovery**	Alternative 14 from 2001 Plan (pg 271)	Hydrologic studies would need to be done to determine the optimal locations. Studies of interest include Donohoe, Lisa C. Selected Hydrologic Data for the Upper Rio Hondo Basin, Lincoln County, New Mexico, 1945-2003. US Department of the Interior, US Geological Survey, 2004.							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	SS	Program	Improve System Efficiency	Reduce losses	**Reduce Reservoir Surface Area**	Alternative 15 from 2001 plan (pg 272)	The surface area of the existing lakes and reservoirs within the planning region can be reduced by ten percent by creating berms around shallow portions of the lakes to confine the water. The 2001 plans calculates the total evaporation from reservoirs (including Bitter Lakes) in the planning area is 18,600 AFY. It follows that a reduction in evaporation of ten percent (1800 AF) would require a reduction of about ten percent in the surface area of the lakes. An alternative method would be by using floating hydraulic suction dredges and floating pipelines to dredge excessive silt from the bottom of the existing reservoirs and use of the pumped slurry to fill shallow portions of the lakes to confine the reservoir area.							The steering committee continues to feel that this alternative is important, however, it has been difficult to implement. Work needs to be done to figure out how to bring this option to reality.
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Improve System Efficiency	Reduce losses	**Reduce Conveyance Losses**	Alternative 16 from the 2001 plan (pg 273)	This alternative is still a concern for this region. The steering committee would like to see more research on this topic, specifically the relationship between bank storage and gaining/losing reaches of the river. The reach from Artesia to Lakewood, for example, is a significant loosing stretch of the river (perhaps as much as 32,000 ac-ft). How much of this loss remains in the system and what is lost to shallow groundwater diverters?							There is some research on this topic from the 1960's and 70's from the Bureau of Geology, but the steering committee has been unable to find the actual report. There is current Bureau research regarding recharge in the Sacramento Mountains and would like to see a similar study for other areas of

Regional Water Planning Update

Projects, Programs, and Policies

Water Planning Region 10: Lower Pecos Valley

Planning Region	County	Regional or System Specific (R), (SS)	Strategy Type (Project, Program or Policy)	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead	Project Partners	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Project	Increase Water Supply	Increase Water Supply	**Import Water from Salt Basin**	Alternative 17 from the 2001 plan (pg 275)	Unappropriated water may exist in some water planning regions in New Mexico. If so, the region with the excess water (i.e. water for which there does not appear to be a foreseeable demand within the 40 year planning cycle) may wish to lease or sell that water to another region where a shortfall exist now or is expected to exist in the near future. One region where an excess amount of water appears to exist at the present time is in the Salt Underground Water Basin which is part of the planning region designated as the Tularosa, Great Salt and Sacramento River Basins.							The steering committee did not generally support this alternative, but felt that the State Engineer at the time had wanted this project included. Additional discussion is needed on this alternative
	De Baca, Lincoln, Chaves, Otero, Eddy		Policy	Protect Existing Supply	Policy Recommendations	**Enhanced Water Right Administration**	Steering Committee Meeting Discussion	Enforcement of existing decrees, permits and contracts is an essential part of market administration. New Mexico water law provides that no new surface uses after 1907 and no new underground uses after declaration of an underground water basin shall be initiated without approval of an application by the OSE. Compact compliance is paramount in regional water planning. All projects, policies, and programs have to be evaluated as to impacts and compliance with the compact. This alternative also encompasses enhanced water right abandonment monitoring. Water rights are often abandoned (fields left fallow) for significant periods of time. Owners of that water right will often return and use that water for a short time before selling it (to prove that the water right is active). Stronger monitoring for this activity should occur. Historical usage can be determined using historical aerial photographs and through ISC database searches). Increased oversight on well construction to ensure that aquifers are properly isolated is also encouraged. The steering committee would also like to see protection of the Water Right Leasing Act from unintended consequences from misuse.	The obligation for enforcement of New Mexico water laws is statutory duty placed upon the OSE.						This alternative suffers from lack of enforcement
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Protect Existing Supply	Environmental Protection	**NEPA, EIS, Archeological Support Programs**	Steering Committee Meeting Discussion	Environmental and historical preservation processes are lengthy and expensive. Many organizations do not have the financial ability to hire the consultants needed to help move these processes as quickly as possible. Acceptance of these documents is also time consuming. We need state support to push for federal acceptance.							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Project	Protect Existing Supply	Increase Water Supply	**Increased Recharge**	Steering Committee Meeting Discussion	One example to increase recharge is tree thinning in the Lincoln National Forest. Another example is reoperation of the "leaky" reservoir sites to be used as recharge locations and not storage locations.							Potential recharge locations were identified by a study done by Don Alam. This report needs to be digitized and made more available. Woods Houghton
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Improve System Efficiency	Reduce Evaporation Losses, Increase Recharge	**Reoperate or Relocate "leaky" Reservoirs to Increase Recharge**	Steering Committee Meeting Discussion	Reoperate or relocate particularly leaky reservoirs to serve as recharge locations and not storage locations. There was discussion of reoperating or relocating Hagerman Reservoir and to control spills in Rocky Arroyo when the reservoir is full (Rocky Arroyo is part of Twin Dams structure, water spills in Rocky Arroyo when the reservoir is full. The group would like to see a flood gate on Rocky Arroyo) – however this has lots of red tape (an act of Congress and Army Corp has control of flood control structures).							

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Projects, Programs, and Policies

Water Planning Region 10: Lower Pecos Valley

Planning Region	County	Regional or System Specific (R), (SS)	Strategy Type (Project, Program or Policy)	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead	Project Partners	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Policy	Protect Existing Supply	Policy Recommendations	**Water Rights for New Domestic Wells**	Steering Committee Meeting Discussion	The intent is not to stop people from drilling new domestic well but to create regulations to monitor and limit the withdrawals. This would require meters on all new domestic wells, a meter reading program, and public education. Additionally, a flat permit fee for developing new domestic wells should be collected and deposited in a general fund. The revenue from this program could be used to buy water rights willing to be retired. Impairment analysis of new well permits should also be considered.	It might be possible to enforce these regulations at a County level						The 40 yr water plan for Eddy County looks at this issue.
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Policy	Protect Existing Supply	Policy Recommendations	**Water Right Abandonment Monitoring**	Steering Committee Meeting Discussion	Water rights are often abandoned (fields left fallow) for significant periods of time. Owners of that water right will often return and use that water for a short time before selling it (to prove that the water right is active). Stronger monitoring for this activity should occur. Historical usage can be determined using historical aerial photographs and through ISC database searches).	NM ISC / OSE						
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Project	Protect Existing Supply	Policy Recommendations	**Compact Compliance Strategies**	Steering Committee Meeting Discussion	There is need for additional studies to determine all the possible options for meeting the Pecos River Compact Obligations. Can the losses from endangered species be shared between NM and TX? Are the impacts of the current strategies (voluntary retirement and groundwater pumping during shortage) as predicted? Have there been unintended consequences? Reliance on groundwater pumping for Compact delivery is worrisome for water users nearby.							All polices, programs and projects should be consistent with appropriation date, date of beneficial use and point of diversion as according to the constitution and the treaty of Guadalupe Hidalgo
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Protect Existing Supply	Data Collection	**Water Quantity and Quality Monitoring**	Steering Committee Meeting Discussion	Additional studies and on-going monitoring of groundwater quality is needed. This data would be used to understand hydraulic connections (such as increased leakage between aquifers) between pumping levels and water quality. Ideally the data would be available in contoured maps of water quality posted on websites and regularly updated (perhaps every 5 years?). The 2012 Pecos River Master Manual has specific, bi-monthly, water quality monitoring requirements at Malaga Bend - are/should there similar requirements at other locations or for groundwater? USGS river flow gages would also need to be supported to couple groundwater trends with surface water trends.							There have been some efforts to accomplish this type of program by PVACD and OSE, however the steering committee would like to see it done throughout the region and with information easily accessible to the public.
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Increase Water Supply	Water Conservation	**Produced Water Reuse**	Steering Committee Meeting Discussion	Oil exploration and water use has expanded significantly in this region since the previous plan was written. The produced water is treated to very high standards and then "wasted" when reinjected. We need stronger incentives to reuse this water. Some oil companies do reuse this water during drilling. Re-examine wastewater and produced water discharge policies and constraints. Would it be possible to use this water to meet Pecos River delivery obligations? The Pecos River is of very poor quality, the treated produced water seems to be higher quality than the river water. Could standards and incentives be developed to make this possible?							There is ongoing research on this issue across the nation, local studies includes current WRRI work (REFERENCE CURRENT WORK??)
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Improve System Efficiency	Water Conservation	**Water Conservation and Drought Preparedness**	Steering Committee Meeting Discussion	Drought contingency plans usually outline water restrictions for communities. Public outreach/education as well as local policy should consider enacting these drought restrictions at all times. Conserve water every year, not just dry years.							

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Water Planning Region 10: Lower Pecos Valley

Planning Region	County	Regional or System Specific (R), (SS)	Strategy Type (Project, Program or Policy)	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead	Project Partners	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Improve System Efficiency	Water Conservation	**Incentives to Preserve Agricultural Water**	Steering Committee Meeting Discussion	Incentives and rate changes need to be implemented to create thoughtful municipal and industrial water development and to preserve agricultural water rights. One example would be the point system used for power development, i.e. certain percentages of the proposed new water use would have to come from reused water etc.						It is currently too easy to retire water from agricultural purposes to transfer to other purposes. The long term impact of this is decreased farming activities and the community and income it supports.	
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Project	Improve System Efficiency	Infrastructure Improvements	**Specific Project Details**	Steering Committee Discussion	Most of the alternatives listed here are supported by actionable projects in the region. These projects range from small water line repairs to large scale aquifer storage and recovery, all with vastly different timelines and funding sources. The steering committee urges law makers and application decision makers to prioritize projects supporting the programs and policies listed here. There are a combined $45 million in water system improvements in the 2016-2020 ICIP list, the 2015 and 2014 Water Trust Board Application, and the 2015 Capital Outlay Bill. As funding for these projects changes frequently, the reader should consult the appropriate websites to learn about these programs.							ICIP projects: http://nmdfa.state.nm.us/ICIP.aspx WTB Projects: http://www.nmfa.net/financing/water-programs/water-project-fund/ Capitol Outlay Projects: http://www.nmlegis.gov/lcs/billfinder/capital_outlay.aspx
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Policy	Protect Existing Supply	Policy Recommendations	**Protect NM Water**	Steering Committee Discussion	The State of New Mexico is to maintain primacy on all water resources used for distribution within the state of New Mexico							This alternative was discussed as a potential conflict of interest, especially in the example of the recent Jumping Mouse Habitat closure in the national forest. Closing this rangeland has impacted many local cattle owners who had rights to graze in this area.
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Policy	Protect Existing Supply	Policy Recommendations	**Limit New Uses**	Steering Committee Discussion	The Steering Committee does not support any new water uses or appropriations that diminishes the current supply. An example is the new application by BOPCO that is protested by the ISC and CID to use 2,000 ac-ft.							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Policy	Protect Existing Supply	Policy Recommendations	**Close the Basin**	Steering Committee Discussion	The basin is considered fully appropriated, but it has not been closed. The steering committee recommends closing the basin.							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Project	Increase Water Supply	Increase Water Supply	**Increase Supply**	Steering Committee Discussion	The Steering Committee supports efforts towards the increasing the available water supply, one example is through the reuse of produced water, another example is through watershed management, but other ideas are welcomed.							Eddy County alone produces 118,000 af per year of produced water, this is 4 times greater than the projected shortfall between supply and demand.
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Protect Existing Supply	Education	**Public Water Education**	Steering Committee Discussion	Increased funding for public education programs, including New Mexico Water Law education. Increased funding for research institutes such as WRRI, etc.							
Lower Pecos	De Baca, Lincoln, Chaves, Otero, Eddy	R	Program	Improve System Efficiency	Regional Collaboration	**Encourage Regionalization of Small Water Systems**	Steering Committee Discussion	Small water systems should be encouraged to work together and pool resources for improvements and cost sharing.							

Appendix 8-B

Infrastructure Capital Improvement Projects

Regional Water Planning Update

Infrastructure and Capital Improvement Projects and Water Trust Board Applications for 2016

Water Planning Region 10: Lower Pecos Valley

Planning Region	County	Regional or System Specific (R),(SS)	Project, Program or Policy	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead (Entity or Organization)	Partners (other entities or participants)	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Berrendo VFS Water Well & Water Storage Tank**	2016-2020 ICIP Project List	Project ID 26426			2018-2019	Single phase project	$ 300,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Dexter Water Towers Improve**	2015 Capitol Outlay Bill SB159		Dexter				$ 100,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Dunken VFD - Water Well for Fire Station**	2016-2020 ICIP Project List	Project ID 19446			2016	Single phase project	$ 100,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Dunken VFD Water Well / Storage Tank**	2016-2020 ICIP Project List	Project ID 23115			2018-2019	Single phase project	$ 300,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**EGP VFD Drill Water Well and Pressurized Water Tank**	2016-2020 ICIP Project List	Project ID 26405			2020		$ 200,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Elk Dam Improvements**	Statewide Acequia Survey, NMAA	To plan, design, and construct improvements am Elk Dam (Pipe)	Elk Dam			Pre-Planning		Pipe	
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Hagerman Water Line RR Crossing**	2015 Capitol Outlay Bill SB159		Hagerman				$ 25,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Hagerman Water Storage Tank**	2015 Capitol Outlay Bill SB159		Hagerman				$ 300,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Lake Arthur Water Systems Improve**	2015 Capitol Outlay Bill SB159		Lake Arthur				$ 90,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Midway VFS Water Well/Storage Tank**	2016-2020 ICIP Project List	Project ID 19429			2018	Single phase project	$ 480,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Penasco VFD Water Storage Tanks**	2016-2020 ICIP Project List	Project ID 19441			2017	Single phase project	$ 250,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Rio Felix VFD - Water Well & Pressurized Storage Tank**	2016-2020 ICIP Project List	Project ID 23140			2016	Single phase project	$ 150,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Sierra VFD - Water Well & Storage Tank**	2016-2020 ICIP Project List	Project ID 26452			2016	Single phase project	$ 150,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**South Main Water Sewer Project**	2016-2020 ICIP Project List	Project ID 27011			2016	Single phase project	$ 2,550,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Storage Tank, booster pumps, piping from well to tank**	2015 WTB application		Town of Hagerman				$ 282,000		
Lower Pecos	Chaves	SS	Project	Improve System Efficiency	Water System Infrastructure	**Well pump and transmission line**	2015 WTB application		Town of Hagerman				$ 1,460,000		
Lower Pecos	Chaves	SS	Project	Quality of Life	Public Parks (local)	**Walking Trail / Water Retention Pond**	2016-2020 ICIP Project List	Project ID 25112			2016	Single phase project	$ 50,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**All Hazard Mitigation Plan**	2017-2021 ICIP Project List	Project ID 31247	Carlsbad				$ 100,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Carlsbad Sewer Improvements**	2017-2021 ICIP Project List	Project ID 19674	Carlsbad				$ 14,860,678		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**CID Bridge Replacement**	2017-2021 ICIP Project List	Project ID 28184	Carlsbad				$ 2,200,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Compost Facility Improvements**	2017-2021 ICIP Project List	Project ID 15131	Carlsbad				$ 88,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Dark Cyn/Pecos River Improvements**	2017-2021 ICIP Project List	Project ID 15917	Carlsbad				$ 1,000,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**Double Eagle Reservoir No. 4**	2017-2021 ICIP Project List	Project ID 22592	Carlsbad				$ 5,061,711		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water System Infrastructure	**Double Eagle Water Wells**	2014 WTB application		City of Carlsbad			Construction	$ 1,500,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**Double Eagle Waterline Improvements Ph. 3**	2017-2021 ICIP Project List	Project ID 15936	Carlsbad				$ 4,711,119		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**Double Eagle Waterline Replacement**	2017-2021 ICIP Project List	Project ID 15932	Carlsbad				$ 9,146,669		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Extend Storm Drain to Chruch Street**	2017-2021 ICIP Project List	Project ID 25100	Carlsbad				$ 3,115,800		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Extend Storm Drain to Greene Street**	2017-2021 ICIP Project List	Project ID 25091	Carlsbad				$ 2,298,200		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Extend Storm Drain to Hagerman Street**	2017-2021 ICIP Project List	Project ID 25099	Carlsbad				$ 1,094,400		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Extend Storm Drain to Lea Street**	2017-2021 ICIP Project List	Project ID 25088	Carlsbad				$ 2,662,400		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Extend Storm Drain to Mckay Street**	2017-2021 ICIP Project List	Project ID 25098	Carlsbad				$ 3,745,300		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Extend Storm Drain to Mermod Street**	2017-2021 ICIP Project List	Project ID 25092	Carlsbad				$ 619,300		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Extend Storm Drain to Normandy Addition**	2017-2021 ICIP Project List	Project ID 25087	Carlsbad				$ 3,103,200		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Extend Storm Drain to Stevens Street**	2017-2021 ICIP Project List	Project ID 25093	Carlsbad				$ 13,040,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Extend Storm Drain to Tansill Street**	2017-2021 ICIP Project List	Project ID 25090	Carlsbad				$ 415,000		

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Planning Region	County	Regional or System Specific (R),(SS)	Project, Program or Policy	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead (Entity or Organization)	Partners (other entities or participants)	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**Fixed Base Radios Read Water Meter System**	2017-2021 ICIP Project List	Project ID 30597	Carlsbad				$ 4,500,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Hope Community Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Hope Community Ditch	Hope Community Ditch			Pre-Planning			
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**Install Gas Driven Generators -Sheeps Draw**	2017-2021 ICIP Project List	Project ID 15095	Carlsbad				$ 500,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water System Infrastructure	**Loving Sewer Collection System Improve**	2016-2020 ICIP Project List		Loving				$ 50,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water System Infrastructure	**Loving Water System Improvements**	2016-2020 ICIP Project List		Loving				$ 50,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**National Parks Hwy Sewer**	2017-2021 ICIP Project List	Project ID 22551	Carlsbad				$ 826,655		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**North Carlsbad Drainage Improvements**	2017-2021 ICIP Project List	Project ID 22545	Carlsbad				$ 900,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**North Loop Waterline Repairs**	2017-2021 ICIP Project List	Project ID 22573	Carlsbad				$ 411,116		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Old Cavern Hwy Sewer**	2017-2021 ICIP Project List	Project ID 22552	Carlsbad				$ 2,698,401		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water System Infrastructure	**Otis MDWC & SWA Water Mains Phase 6**	2016-2020 ICIP Project List		Otis				$ 50,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water System Infrastructure	**Otis MDWC & SWA Water Mains Phase 8**	2016-2020 ICIP Project List		Otis				$ 15,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Reline 24 Inch Effluent Pipeline**	2017-2021 ICIP Project List	Project ID 19677	Carlsbad				$ 2,944,769		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Sewer Collection Office Building**	2017-2021 ICIP Project List	Project ID 22555	Carlsbad				$ 406,778		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Sewer Line Rehab Program**	2017-2021 ICIP Project List	Project ID 22566	Carlsbad				$ 2,349,774		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Sewer Manhole Rehab.**	2017-2021 ICIP Project List	Project ID 22554	Carlsbad				$ 700,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**Sheep's Draw Reservoir #5**	2017-2021 ICIP Project List	Project ID 22568	Carlsbad				$ 4,593,760		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**Sheep's Draw Well #6 Replacement**	2017-2021 ICIP Project List	Project ID 15126	Carlsbad				$ 2,664,954		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**Sheep's Draw Well 6 Improvements**	2017-2021 ICIP Project List	Project ID 22572	Carlsbad				$ 2,331,954		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**Sheep's Draw Well Repairs**	2017-2021 ICIP Project List	Project ID 28162	Carlsbad				$ 700,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Sod/Tree Farm Development**	2017-2021 ICIP Project List	Project ID 15840	Carlsbad				$ 55,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**South Carlsbad Sewer Improvement**	2017-2021 ICIP Project List	Project ID 15165	Carlsbad				$ 8,719,215		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**South Carlsbad Storm Drain Improvements**	2017-2021 ICIP Project List	Project ID 19547	Carlsbad				$ 1,990,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water System Infrastructure	**South Wellfield/Double Eagle water wells**	2015 WTB application		City of Carlsbad				$ 2,500,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Standpipe Road Sewer Improvements Ph. 1-2**	2017-2021 ICIP Project List	Project ID 22553	Carlsbad				$ 1,780,659		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Wastewater	**Wastewater effluent reuse Phase 5**	2015 WTB application		City of Carlsbad				$ 2,500,000		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water System Infrastructure	**Water System Improvements**	2015 WTB application		Otis MDWC & SWA				$ 499,500		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Water Supply	**Water System Improvements**	2017-2021 ICIP Project List	Project ID 22563	Carlsbad				$ 16,474,350		
Lower Pecos	Eddy	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**West Carlsbad Storm Drain Improvements**	2017-2021 ICIP Project List	Project ID 19555	Carlsbad				$ 960,000		
Lower Pecos	Eddy	SS	Project	Quality of Life	Public Parks (local)	**Golf Course Irrigation**	2017-2021 ICIP Project List	Project ID 21325	Carlsbad				$ 250,000		
Lower Pecos	Eddy	SS	Project	Quality of Life	Public Parks (local)	**Lake Carlsbad Erosion Control**	2017-2021 ICIP Project List	Project ID 9779	Carlsbad				$ 1,250,000		
Lower Pecos	Eddy	SS	Project	Reduce Demand	Public Parks (local)	**Golf Course Effluent Reuse Project Ph. 2-5**	2017-2021 ICIP Project List	Project ID 11377	Carlsbad				$ 2,100,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**A Sanchez Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to A. Sanchez Ditch	A. Sanchez Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**Alto Dam Compliance & Improvements**	2017-2021 ICIP Project List	Project ID 23665	Ruidoso				$ 20,500,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**Alto Water Storage Tank East**	2017-2021 ICIP Project List	Project ID 29897	Ruidoso				$ 5,000,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**Alto Water Storage Tank West Improvements**	2017-2021 ICIP Project List	Project ID 29896	Ruidoso				$ 5,000,000		

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Water Planning Region 10: Lower Pecos Valley

Planning Region	County	Regional or System Specific (R),(SS)	Project, Program or Policy	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead (Entity or Organization)	Partners (other entities or participants)	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Ambrocio Chavez Ditch No 1 Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Ambrocio Chavez Ditch No. 1	Ambrocio Chavez Ditch No. 1			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Ambrocio Ditch #1 Improvements**	Statewide Acequia Survey, NMAA	To plan, design, and construct improvements #1 Ambrocio Ditch #1 (Diversion Dam)	Ambrocio Ditch #1			Pre-Planning		Diversion Dam	
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Ambrocio/Pablo Chavez Acequia Improvements**	Statewide Acequia Survey, NMAA	To plan, design, and construct improvements ia Ambrocio/Pablo Chavez Acequia (Diversion Dam)	Ambrocio/Pablo Chavez Acequia			Pre-Planning		Diversion Dam	
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Ambrosio Pablo Chavez Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Ambrosio - Pablo Chavez Ditch	Ambrosio - Pablo Chavez Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**Aqua Fria Water Distribution System Improvements**	2015 WTB application		City of Ruidoso Downs				$ 849,952		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**Camelot Water Storage Tank #1**	2017-2021 ICIP Project List	Project ID 29880	Ruidoso				$ 155,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**Camelot Water Storage Tank 2**	2017-2021 ICIP Project List	Project ID 29881	Ruidoso				$ 505,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Chosas Ditch North Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Chosas Ditch North	Chosas Ditch North			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Chosas Ditch South Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Chosas Ditch South	Chosas Ditch South			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Storm/Surface Water Control	**Drainage Improvements**	2017-2021 ICIP Project List	Project ID 25434	Ruidoso				$ 405,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**F Coe Ditch North & South Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to F. Coe Ditch North & South	F. Coe Ditch North & South			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**F Sanchez Ditch North & South Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to F. Sanchez Ditch North & South	F. Sanchez Ditch North & South			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**Fire Hydrant Replacement**	2017-2021 ICIP Project List	Project ID 28005	Ruidoso				$ 200,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Public Safety Equipment/Bldgs	**Flood Mitigation Plan/PER**	2017-2021 ICIP Project List	Project ID 27991	Ruidoso				$ 100,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**Fort Stanton Water Line Improvements**	2017-2021 ICIP Project List	Project ID 29892	Ruidoso				$ 3,135,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Frank Allison Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Frank Allison Ditch	Frank Allison Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**G Coe Ditch North & South Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to G. Coe Ditch North & South	G. Coe Ditch North & South			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**Grindstone Water Storage Improvement 3,000,000**	2017-2021 ICIP Project List	Project ID 29899	Ruidoso				$ 3,000,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Hale Ditch North Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Hale Ditch North	Hale Ditch North			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Hale Ditch South Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Hale Ditch South	Hale Ditch South			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Hilbern Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Hilbern Ditch	Hilbern Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**Hollywood Water Storage Tank Improvement**	2017-2021 ICIP Project List	Project ID 29882	Ruidoso				$ 22,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**J Tully Ditch North Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to J. Tully Ditch North	J. Tully Ditch North			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**J Tully Ditch South Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to J. Tully Ditch South	J. Tully Ditch South			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**L Gallegos Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to L. Gallegos Ditch	L. Gallegos Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Leopoldo Gonzales Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Leopoldo Gonzales Ditch	Leopoldo Gonzales Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Lincoln Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Lincoln Ditch	Lincoln Ditch			Pre-Planning			

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Water Planning Region 10: Lower Pecos Valley

Planning Region	County	Regional or System Specific (R),(SS)	Project, Program or Policy	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead (Entity or Organization)	Partners (other entities or participants)	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**Little Dragaon Water Storage Tank Improvementst**	2017-2021 ICIP Project List	Project ID 29883	Ruidoso				$ 1,000,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Lutz Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Lutz Ditch	Lutz Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Environmental Protection	**Mechanical Removal of non-native phreatophytes to watershed**	2015 WTB application		Upper Hondo SWCD				$ 500,000		This project has already begun
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Mes Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Mes Ditch	Mes Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**Meter Replacement Project**	2015 WTB application		Village of Capitan				$ 286,575		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**Moon Mountain Water Tank Improvements**	2017-2021 ICIP Project List	Project ID 29895	Ruidoso				$ 500,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Newcomb Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Newcomb Ditch	Newcomb Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Picacho Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Picacho Ditch	Picacho Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-	**Pinecliff Water Storage Tank Improvement**	2017-2021 ICIP Project List	Project ID 29889	Ruidoso				$ 500,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Pope Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Pope Ditch	Pope Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Protectora Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Protectora Ditch	Protectora Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Providencia Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Providencia Ditch	Providencia Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Other	**Removal of Trees for Fire Mitigation**	2017-2021 ICIP Project List	Project ID 26248	Ruidoso				$ 350,000		
Lower Pecos??	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**Replacement of Distribution Lines**	2014 WTB application		Alto Lakes SWCD				$ 1,502,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Ross Coe Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Ross Coe	Ross Coe			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**San Patricio Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to San Patricio Ditch	San Patricio Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**SCADA**	2015 WTB application		Village of Capitan				$ 225,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Wastewater	**Sewer Line Relocation-FEMA**	2017-2021 ICIP Project List	Project ID 25154	Ruidoso				$ 30,000,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Acequia Infrastructure	**Storm Ditch Improvements**	Statewide Acequia List (NMAA)	To plan, design, and construct improvements to Storm Ditch	Storm Ditch			Pre-Planning			
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**Wastewater Reuse Project**	2017-2021 ICIP Project List	Project ID 29891	Ruidoso				$ 25,000,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**Water Infrastructure Improvements**	2017-2021 ICIP Project List	Project ID 25446	Ruidoso				$ 5,000,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Adm/Service Facilities (local)	**Water Maintenance Facility**	2017-2021 ICIP Project List	Project ID 27949	Ruidoso				$ 955,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Water System Infrastructure	**Water Transmission Pipeline**	2015 WTB application		Village of Corona				$ 325,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**West Backwash Storage Tank**	2017-2021 ICIP Project List	Project ID 29885	Ruidoso				$ 300,000		
Lower Pecos	Lincoln	SS	Project	Improve System Efficiency	Utilities (publicly-owned)	**West Backwash Storage Tank #2**	2017-2021 ICIP Project List	Project ID 29886	Ruidoso				$ 100,000		
Lower Pecos	Lincoln	SS	Project	Increase Water Supply	Water System Infrastructure	**Alto Water Treatment Plant Upgrade**	2017-2021 ICIP Project List	Project ID 25450	Ruidoso				$ 10,950,000		
Lower Pecos	Lincoln	SS	Project	Increase Water Supply	Wastewater	**New Wastewater Reuse Project**	2017-2021 ICIP Project List	Project ID 27988	Ruidoso				$ 1,340,000		
Lower Pecos	Otero	SS	Project	Improve System Efficiency	Water System Infrastructure	**Mescalero Community Water/Sewer Line Project**	2016-2020 ICIP Project List	The Mescalero Apache Tribe is requesting funding to update and replace existing water/sewer lines in the housing areas within the community	Mescalero Apache Tribe		2016	Yes, still in planning phase	$ 21,335,000		Project ID: 29627
Lower Pecos	Otero	SS	Project	Improve System Efficiency	Environmental Protection	**Turkey Pen Canyon Watershed Improvements**	2015 WTB application	The steering committee thought this was a great example of watershed restoration	Mescalero Apache Tribe				$ 750,000		This project has already begun
Lower Pecos	Otero	SS	Project	Improve System Efficiency	Water System Infrastructure	**Village Water Improvement**	2015 WTB application		Mescalero Apache Tribe				$ 5,000,000		
Lower Pecos	Otero	SS	Project	Improve System Efficiency	Water System Infrastructure	**Water System compliance/improvements**	2015 WTB application		Mescalero Apache Tribe				$ 1,272,000		