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1. Introduction

The Estancia Basin Water Planning Region, which encompasses the majority of Torrance County and parts of Bernalillo and Santa Fe counties (Figure 1-1), 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 NMISC-accepted Estancia Basin Regional Water Plan (RWP) was developed in two phases: a Phase I Report that addressed water supply and demand data, completed in January 1997 (JSAI et al., 1997), and an analysis of potential strategies for meeting the region's projected demands, completed in January 1999 (Corbin Consulting, Inc., 1999). The 1999 plan (and by reference the 1997 Phase I Report) was accepted by the NMISC in April 1999. This plan was updated in 2010, with the release of the *Estancia Basin Regional Water Plan: Year 2010 Update* in February 2010 (2010 RWP update [EBWPC and HR, 2010]). The accepted and updated Estancia Basin RWPs covered the area within the Estancia Underground Water Basin (UWB) only and did not include the areas within the planning region (in eastern and southern portions of Torrance County) that are outside of the Estancia UWB.

The purpose of this document is to update the accepted RWP to reflect new and changed information related to water planning in the Estancia Basin Water Planning 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. This information is provided for the entire planning area not just the Estancia UWB. Accordingly, the following sections summarize key information in the accepted and updated plans 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 Estancia Basin Water Planning Region.
- Presents recent water use information and develops updated projections of future water use using the common technical approach developed by the NMISC, in order to facilitate incorporation into the New Mexico State Water Plan.
- 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 Estancia Basin 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 RWP update is based on current published studies and data and information supplied by water stakeholders in the region.

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):

- 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 Estancia Basin 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 accepted and updated RWPs; key information from those plans is summarized in Section 5, with new information that has become available since 2010 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.

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 supply is based on recent diversions, which provide a measure of supply that considers both physical supply and legal restrictions (i.e., the diversion is physically available, permitted, and in compliance with water rights policies) and thus reflects the amount of water that can actually be used by a region. An estimate of supply during future droughts is also developed by adjusting the recent diversion 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 using methods for each category that are applied consistently 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.

- 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 accepted and updated RWPs. Section 6 provides updated population and water use data, which are then used to develop updated projections of future water use.
- 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) is 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.

2. Public Involvement in the Planning Process

3. Description of the Planning Region

This section provides a general overview of the Estancia Basin Water Planning Region. Detailed information, including maps illustrating the land use and general features of the region, was provided in the accepted and updated RWPs; 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 Estancia Basin Water Planning Region is located in central New Mexico, covering the majority of Torrance County and the portions of Santa Fe and Bernalillo counties that overly the Estancia UWB. Approximately 80 percent of the land area within the hydrographic boundaries of the Estancia UWB is in Torrance County. Santa Fe and Bernalillo counties also play significant roles in the Estancia Basin due to burgeoning residential housing that is expanding eastward into the planning region.

The region is bounded on the north by the crest of the San Pedro Mountains in Santa Fe County and by San Miguel County, on the west by the Estancia UWB boundary and by Valencia County, on the south by Lincoln and Socorro counties, and on the east by Guadalupe County (Figure 3-1). The total area of the planning region is approximately 3,800 square miles, but only

about 2,200 square miles fall within the Estancia UWB. The total area of the planning region is distributed among the three counties as follows:

- Santa Fe County: 435 square miles
- Bernalillo County: 113 square miles
- Torrance County: 3,278 square miles

The planning region encompasses varied terrain, from mountainous areas in the north, west, and south, to plains and rangeland in the central and south-central portions of the region. Elevations range from 10,097 feet above mean sea level at Manzano Peak to 6,050 feet in the Laguna del Perro area.

Natural resources include sand and gravel, forest products, and minerals, including four precious metals mines or prospects and one uranium mining claim (Corbin Consulting, Inc., 1999). Exploration wells have found very deep oil and gas resources (Broadhead, 1997); to date, these have not been developed, but as oil and gas prices rise, increased oil and gas activities are likely (EBWPC and HR, 2010). The 2010 RWP update reiterated the assertion in the Phase I report that the region's groundwater, particularly the Valley Fill aquifer generally located in the central portion of the basin, is its most important natural resource.

3.2 Climate

The varied terrain of the planning region results in significant climate variations. Average annual precipitation, including both snowmelt and rainfall, ranges from about 12 inches in the lower elevations (Pedernal 4 E) to more than 20 inches along the eastern slopes of the Sandia and Manzano Mountains. Most of the region receives 14 to 18 inches of precipitation annually. Very little runoff occurs from rainfall or snowmelt due to the high permeability of the upland areas (fractured limestone); thus a reduction in precipitation would result in less recharge.

Further information regarding climate and its effect on the region's water supplies is provided in Section 5.1.

3.3 Major Surface Water and Groundwater Sources

No significant streams exist in the region and most surface water flow occurs as ephemeral flow in drainages and arroyos. Two small freshwater lakes and numerous playa lakes are present within the planning region. The region relies solely on groundwater and precipitation for water supply, and the vast majority of the current water supply is derived from the Valley Fill aquifer system generally located in the central portion of the Estancia Basin.

The primary OSE-declared Underground Water Basin (UWB) in the region is the Estancia UWB; small portions of the Upper Pecos, Fort Sumner, Roswell, Tularosa, Rio Grande (Middle),

and Sandia UWBs are also present beneath the peripheries of the region. (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.) While the Estancia UWB supplies most of the region's population and economy, the eastern and southern parts of the region obtain water from adjacent UWBs that are shared with other regions:

- Upper Pecos UWB: Mora-San Miguel-Guadalupe region
- Fort Sumner UWB: Mora-San Miguel-Guadalupe and Lower Pecos Valley regions
- Roswell UWB: Mora-San Miguel-Guadalupe and Lower Pecos Valley regions
- Tularosa UWB: Tularosa-Sacramento-Salt, Lower Rio Grande, and Socorro-Sierra regions
- Rio Grande (Middle) UWB: Socorro-Sierra and Middle Rio Grande regions

The Sandia UWB, shared with the Middle Rio Grande region, is present in a small part of the northwest portion of the Estancia Basin and supplies water to domestic wells. A map showing the UWBs in the region is provided in Section 4.7.2.

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 Estancia Basin Water Planning Region includes all of Torrance County and small portions of Santa Fe and Bernalillo counties that, because of their residential population, play significant roles in the region. The total 2013 population of Torrance County was 15,717 (U.S. Census Bureau, 2014a). No reliable figures for the portions of Santa Fe and Bernalillo counties that fall within the Estancia Basin region are available for 2013. As shown in Table 3-1a, between 2010 and 2013, the population of Torrance County declined from 16,383 to 15,717 (about 4.1 percent).

The portion of Santa Fe County within the Estancia Basin Water Planning Region had a population of 10,014 in 2010, as determined by DBS&A from U.S. Census data. This area has substantial land dedicated to irrigated agriculture.

The small portion of Bernalillo County within the Estancia Basin Water Planning Region had 6,297 residents in 2010, as determined by DBS&A from U.S. Census data. The area is mostly residential with no irrigated agriculture and minimal ranching activity.

The largest employment categories are education/healthcare, retail trade, professional, scientific and management, followed by arts, entertainment, recreation, and accommodation and food services (Table 3-1c). The greatest amount of water has been used for irrigated agriculture.

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

4. Legal Issues (To Be Prepared by the State)

5. Water Supply

This section provides an overview of the water supply in the Estancia Basin 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 *Updated Regional Water Planning Handbook* (NMISC, 2013) 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 prior Estancia Basin RWPs (JSAI et al., 1997; Corbin Consulting, Inc., 1999; EBWPC and HR, 2010) 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 Estancia Basin region are:

- Large-scale agricultural pumping has been occurring in the region since about 1950. Groundwater mining (i.e., pumping more water from the aquifer than is replenished) has resulted in serious water level declines in the Valley Fill aquifer system, causing some wells to go dry, and computer modeling of the basin predicts that water levels will continue to decline in the coming decades. Average water level declines are over 1 foot per year in the Valley Fill, which is on average only 131 feet thick (EBWPC and HR, 2010). However, declines up to 5 feet per year in the Valley Fill have been observed.

- For many areas, the Valley Fill aquifer is underlain by other geologic formations that have been designated as critical management areas (CMAs). The Estancia UWB guidelines adopted by the NMOSE do not allow the deepening of wells producing from the Valley Fill aquifer into an underlying CMA.

- New appropriations of groundwater are not permitted within the Estancia UWB. Groundwater rights may be obtained by transferring a valid water right that has been put to beneficial use from an owner who is, willing, to transfer that right. Water right licenses, declarations, and permits in the Estancia UWB far exceed the amount of water that has been put to beneficial use. The NMOSE calculated the total irrigated agricultural pumping for the basin in 2010 to be 79,298 ac-ft/yr (Longworth et al., 2013), much less than the permitted diversion of 158,475 ac-ft/yr (HydroResolutions, LLC, 2013).

- The Estancia UWB guidelines limit the number of years in which extensions of time may be filed to 10 years. Permits are typically conditioned to require that proof of beneficial use be submitted within 4 years following the permit approval date. If the application of water to beneficial use cannot be filed within the specified time, an extension of time may be filed. More than 35 permits have been canceled because proof of beneficial use was not filed within 10 years.

- Regional water planning efforts by the EBWPC have focused on preventing transfers to other basins and achieving water self-sufficiency and sustainability.

- 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 individual farms.

- Most irrigation wells are not metered, which limits the ability of models to accurately characterize the stresses on the water resources.

- The increase in population since the release of the 1999 regional water plan (Corbin Consulting, 1999) has resulted in an increase in domestic use of water in the Estancia Basin. In addition, proposed alternative energy projects and other business ventures will increase demand. To meet these new demands, other water rights, such as irrigation rights, will have to be discontinued. The transfer of irrigation rights to other uses results in a decrease in pumping, because only the consumptive use amount, not the diversion amount, may be transferred.

- Interest in the development of brackish groundwater resources with associated development of two intra-basin pipelines could help meet the region's water demand, but could also increase stress on the aquifer.

- The updated RWP (EBWPC and HR, 2010) expressed concern about NMOSE administrative policies that restrict transfers of water rights to alternate points of diversion within the basin and the impact of such restrictions on economic development along the I-40 corridor. To provide a water source alternative and allow farmers flexibility to lease their water over the short term, the EBWPC identified development and construction of an intra-basin pipeline(s) as one of its five-year regional water plan priorities to allow the physical transfer of water within the region.

- Notices of intent have been filed by three entities under New Mexico Statutes 72-12-25 through 72-12-28 to drill up to 32 wells, each over 2,500 feet in depth, and divert up to 50,500 acre-feet per year of non-potable groundwater. These notices have not yet been followed by any action by the applicants.

- Reducing depletions in the Valley Fill aquifer system and achieving self-sufficiency and sustainability with respect to water supply and demand are paramount to the economic and cultural viability of the Estancia Basin.

- Nitrate contamination of groundwater is a concern because of the high density of septic tanks in the region (EBWPC and HR, 2010).

- Saline water may be migrating into areas with better water quality.

- Critical issues to better understand are the connection between the Madera and Valley Fill aquifers and the potential for subsidence in the Valley Fill and saline water intrusion (EBWPC and HR, 2010).

- Forest restoration efforts have helped to reduce the risk of wildfire, but the reduction in evapotranspiration from reduced vegetation is not easy to measure, particularly during dry periods when the remaining vegetation transpires the limited amount of precipitation. Continued monitoring will be crucial to understanding the role vegetation management plays on the region's water budgets.

5.1 Summary of Climate Conditions

The accepted regional water plan (JSAI et al., 1997) included an analysis of historical precipitation in the Estancia UWB. This section provides an updated summary of temperature, precipitation, snowpack conditions, and drought indices pertinent to the entire planning region (Section 5.1.1). Studies relevant to climate change and its potential impacts to water resources in New Mexico and the Estancia Basin Water Planning 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 Santa Fe, Bernalillo, and Torrance counties (within the planning region) and identifies two stations that were used for detailed 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. The region contains no snow course or snowpack telemetry (SNOTEL) stations that can be used to document snowfall in the region. 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 two representative 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 at the two representative stations in the planning region. Total annual precipitation for the selected climate stations is shown in Figure 5-4.

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.

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 Estancia Basin Water Planning Region falls primarily within New Mexico Climate Division 6 (the Central Highlands Climate Division) with a small portion of the southwestern corner of the region in Division 5 (the Central Valley Climate Division) (Figure 5-1). Figure 5-6 shows the long-term

PDSI for these two climate divisions. Of interest are the large variations from year to year in both divisions, which are similar in pattern though not necessarily in magnitude.

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 1930s, the 1950s, the early 2000s, and in recent years (2011 to 2013) (Figure 5-6). The PDSI indicates that the region can expect protracted periods of drought (as occurred 1950-1958) and moderate-length wet periods similar to those in 1905-1909 and 1985-1989). However, given that the period of record is relatively short, one should not expect this century to necessarily be patterned after the last.

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 long-lived 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 of 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 of 5° to 10°F by the end of the century (Hurd and Coonrod, 2008; USBR, 2011). Predictions of precipitation changes are

subject to greater uncertainty, particularly regarding precipitation during the summer monsoon season in the southwestern U.S.

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 projected frequency and severity of flooding.

To minimize the impact of these changes, it is imperative that New Mexico plan for dealing with 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 in the Estancia Basin are very minor and supply only approximately 0.1 percent of the water currently diverted in the Estancia Basin Water Planning Region, with its sole use for livestock. The major surface watershed boundaries in the planning region are shown on Figure 5-7.

There are no major or perennial streams, and streamflow is therefore not monitored in the planning region. The springs in the Manzano Mountains at the western edge of the planning region are the only freshwater riparian areas of note in the region. In ephemeral streams, flows vary from a typical condition of no flow to several thousand cubic feet per second. More than 30 springs are present in the basin and some sustain surface flows for short distances.

No fresh water lakes or reservoirs with greater than 5,000 acre-feet storage capacity are present in the planning region (Figure 5-7), but two small dams store ephemeral flows. Runoff is locally captured in stock tanks and in the two small freshwater lakes, Manzano and Sherwood Forest Lakes, created to capture ephemeral streamflows. The Estancia Basin once contained an ancient lake, the remnants of which have been studied by Keyes (1903) and Meinzer (1911). The lake existed during the Pleistocene Age, when precipitation was greater and temperatures were lower (Leopold, 1951). Because the Estancia Basin is a closed basin, the water in this lake (prior to pumping) discharged through evaporation, leaving behind numerous playa lakes where salt has

been harvested for centuries (Titus, 1973). At least 85 saltwater lakes, such as Laguna del Perro, which has a surface area of more than 13,000 acres, are present in the central part of the basin.

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 don-federal dams are ranked as being in good, fair, poor, or unsatisfactory condition. Unsatisfactory conditions are defined as "dam safety deficiency . . . that requires immediate or emergency remedial action for problem resolution" (NMOSE, 2014b). Dams with unsatisfactory conditions are those that require immediate or remedial action. The two dams within the Estancia Basin region have not been identified in recent inspections as being deficient, with high or significant hazard potential.

5.3 Groundwater Resources

Groundwater accounted for about 99.9 percent of all water depletions in the year 2010, with its primary use being for irrigated agriculture (Longworth et al., 2013). As described in Chapter 4, the Estancia Basin Water Planning Region contains seven declared groundwater basins (Figure 4-1). The Estancia Basin is contained wholly within the water planning region, and according to JSAI et al. (1997), 98 percent of the water pumped in the Estancia Basin is from the Valley Fill aquifer. Review of data compiled by Longworth et al. (2013) shows that the total from the Valley Fill in 2010 is 92 percent. Thus, the focus of the Estancia Basin Regional Water Plan is on the Valley Fill aquifer, but other geologic formations, described in Section 5.3.1, provide water to domestic and stock wells.

5.3.1 Regional Hydrogeology

The geology that controls groundwater occurrence and movement within the planning region was described in the accepted and updated RWPs (JSAI et al., 1997; Corbin Consulting Inc., 1999; EBWPC and HR, 2010), based on studies by Smith (1957), Titus (1969, 1980), and Hawley (2004, 2005). In addition to the Valley Fill aquifer in the Estancia Basin has multiple aquifer (water-bearing) units, including the Madera Limestone, the Abo-Yeso Formation, and the San Andres-Glorieta Formation, that provide water to numerous domestic wells, stock wells, water systems, and irrigation wells. 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.

Three physiographic regions exist within the planning region (ArcGIS USGS, 2015). From the west to the east, these are:

- Basin and Range (Mexican Highland Section)
- Basin and Range (Sacramento Section)

- Las Vegas Plateau

Figure 5-10 shows the approximate extents of these areas within the planning region.

Geologic strata exposed in the planning region range from crystalline bedrock to sedimentary units such as shale, sandstone, and limestone, to unconsolidated valley fill deposits. The geologic formations present in planning region include (from oldest to youngest):

- Precambrian-age rock
- Pennsylvanian-age rock including the Sandia and Madera Formations
- Permian-age rock including the Abo, Yeso, Glorieta, and San Andres Formations
- Triassic-age rock including the Santa Rosa Formation and Quaternary-age sediments including valley fill

The major aquifers in the planning region consist of:

- The Madera Group in the west-central and northwestern portions of the basin consists of limestone, with sandstone and shale.
- The Yeso Formation, composed of sandstone, limestone, and gypsum, is present in the areas north and east of Chupadera Mesa; Mountainair has water supply wells in the Yeso.
- The Glorieta Sandstone is an important aquifer beneath valley fill near Lobo Hill.
- The Valley Fill aquifer system extends across about 625 square miles of the central portion of the basin. It is composed of up to 400 feet of sand, silt, and gravel, but the thickness decreases to a feather edge toward the margins of the basin floor. Most of the irrigation wells in the basin draw from this aquifer.

In bedrock aquifers, fracturing tends to enhance well yield. Other units provide minor water supplies for domestic and stock purposes, such as the Abo Formation, Triassic-age rocks, and thin deposits of alluvium in drainages. The Precambrian-age formations provide relatively limited quantities of water to wells. White (1994) provides an excellent overview of the water-bearing properties of the geologic formations in the Estancia Basin. The San Andres Limestone lies above the water table where present and is not considered to be an aquifer within the Estancia Basin (EBWPC and HR, 2010).

5.3.2 Aquifer Conditions

As reported in the accepted and updated RWPs (JSAI et al., 1997; Corbin Consulting Inc., 1999; EBWPC and HR, 2010), the primary aquifer in the planning region is the Valley Fill aquifer

system. Wells completed in this aquifer are capable of producing hundreds of gallons per minute (gpm) (EBWPC and HR, 2010). Recent work by Hawley (2004, 2005) suggests that the effective saturated portion of the valley fill may be much more limited in the east-west direction than previously thought.

Other aquifers in the region are generally less productive. Wells completed in the Madera Group are capable of producing anywhere from 1 to 1,000 gpm, but the vast majority produce between 1 and 15 gpm (EBWPC and HR, 2010). Wells completed in the Yeso Formation are capable of producing as much as 3,000 gpm (JSAI et al., 1997), but most supply less than 15 gpm. Wells producing from the Glorieta Sandstone are capable of producing several to more than 1,000 gpm, but the productivity is a function of the amount of fracturing present in the area (Smith, 1957).

While the Madera can be very productive, many wells drilled into the formation are dry due to the fractured nature of the rock in the northeast side of the Estancia Basin Water Planning Region (Titus, 1980; White, 1994). Limestones typically have very low primary porosity and are productive only where fractured and (or) dissolved by solution. The sandstones in the lower member of the Madera do not appear to yield much water to wells or springs (Bartolino et al., 2011). The town of Encino, in the eastern part of the Estancia Basin Water Planning Region, receives its water from the town of Vaughn, outside of the region (Phillips, 2015). Groundwater quality and quantity in local aquifers were insufficient to meet Encino's water demands.

In order to evaluate changes in water levels over time, the U.S. Geological Survey (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 5 monitor wells with longer periods of record and are shown on Figure 5-12. Examination of hydrographs for wells completed in the Valley Fill aquifer system in the northern (350344106004601) and southern (343443106024401) portions of Estancia Basin show a long-term trend of decreasing water levels. The average rate of decline in those USGS wells with decreasing water levels is about 1.23 ft/yr (from 1985 to 2014).

HydroResolutions, LLC (2013, 2014) recently evaluated groundwater level data from wells within the Estancia Basin that are included in the Estancia Basin Water Planning Committee (EBWPC) hydrogeologic monitoring program and water level data from USGS monitor wells dating back to the 1950s. Water level monitoring in the alluvial aquifer in the northern, central, and southern parts of the basin show an overall decrease in water levels since about 1950, with a tapering off of the decline rate starting around 1985 in response to increased annual precipitation (with a lag time of five years). HydroResolutions (2013) showed that changes in water levels vary from a 5-foot decline per year to no change, with the greatest decline in the central part of the basin near high-capacity irrigation pumping wells. In some of the wells within the EBWPC network, water levels have risen since monitoring began in 2008. The different water level trends in these wells illustrate the complexity of the basin hydrology.

The aquifers in the planning region are generally recharged through direct infiltration of precipitation, infiltration of surface water runoff in stream channels, arroyos, or road ditches, and infiltration of wastewater discharged to septic systems (Bartolino et al., 2011). The RWPs and the 2013 HydroResolutions, LLC report provided the following published estimates of recharge in the region, both for the Valley Fill aquifer system:

- 22,000 acre-feet per year (Keyes and Frost, 2001)
- 37,800 acre-feet per year (Corbin Consulting Inc., 1999)
- 50,000 acre-feet per year (Smith, 1957)
- 38,000 acre-feet per year (JSAI et al., 1997)
- 30,100 acre-feet per year (Shafike and Flanigan, 1999)

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

- Edgewood (Estancia)
- Entranosa Water & Wastewater Association (Estancia)
- Estancia (Estancia)
- Moriarty (Estancia)
- Mountainair (Estancia)
- Tranquillo Pines (Middle Rio Grande)
- Willard (Estancia)

In addition to these well fields, numerous irrigation, domestic, and stock wells are located throughout the Estancia UWB.

5.4 Water Quality Assessment

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 Estancia Basin Water Planning Region is evaluated through periodic monitoring and comparison of sample results to pertinent water quality standards. The limited data available indicate that the quality of the surface water is highly variable. Spring-flow

quality, as reflected by electrical conductivity, has been reported to range from 151 to 1,700 microSiemens per centimeter (μS/cm). The water quality standard for electrical conductivity for the designated use of public water supply is less than 300 μS/cm (NMWQCC, 2002). No water quality analyses for Manzano Lake and Sherwood Forest Lake have been reported, but it is thought that the lakes probably have good water quality based on their location in the mountains. The salt lakes in the central basin receive groundwater discharge and have very high concentrations of total dissolved solids (TDS) and specific conductance ranging from 20,500 μS/cm to 187,000 μS/cm.

Two lakes and one playa within the Central Closed watershed have been listed on the 2012-2014 New Mexico 303(d) list (NMED, 2014a). This list is prepared by NMED to comply with Section 303(d) of the federal Clean Water Act, which requires each state to identify surface waters within its boundaries that are not meeting or not expected to meet water quality standards. 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 the lakes and playa that have been identified as having impaired water quality; these have not yet been fully assessed. Table 5-8 provides listing information for those reaches.

In evaluating the impacts of the 303(d) list on the regional water planning process, it is important to consider the nature of water quality impairment and its effect on potential use. Problems such as stream bottom deposits and turbidity will not necessarily make the water unusable for irrigation or even for domestic water supply (if the water is treated prior to use). However, the presence of the impaired reaches illustrates the degradation that can occur in the water supply, and some of these impairments can be very disruptive to a healthy aquatic community.

Generally the quality of groundwater in the planning region is highly variable, ranging from relatively fresh water in the Madera limestone and in parts of the alluvial aquifer to relatively salty, low-quality water around the playa lakes and in the deeper aquifers. In the Valley Fill aquifer system, the salinity of the groundwater is much higher in the east-central portion of the basin due to natural evapotranspiration of water in the closed basin.

The primary sources of man-made contamination in the planning region are leaking underground storage tanks and septic tanks.

Specific sources that have the potential to impact either surface or groundwater quality in the future are discussed below. Sources of contamination are considered as one of two types: (1) point sources (Section 5.4.1), if they originate from a single location, or (2) nonpoint sources (Section 5.4.2), if they originate over a more widespread or unspecified location. Information on both types of sources is provided below.

5.4.1 Point Sources

Point source discharges to surface water must comply with the Clean Water Act and the New Mexico Water Quality Standards (20 NMAC 6.4.1) by obtaining a National Pollutant Discharge and Elimination System (NPDES) permit to discharge. The only NPDES-permitted discharge in the planning region (Figure 5-14) is an inactive location listed as a minor discharge from HAW Farms.

The NMED Ground Water Bureau regulates facilities with wastewater discharges that have a potential to impact groundwater quality. These facilities must comply with the New Mexico Water Quality Act (NMSA 1978, §§ 74-6-1 through 74-6-17) and the New Mexico Water Quality Control Commission (NMWQCC) regulations (NMWQCC, 2002) and obtain approval of a discharge plan, which provides for measures needed to prevent and detect groundwater contamination. A variety of facilities fall under the discharge plan requirements, including mines, sewage dischargers, dairies, food processors, sludge and septage disposal facilities, and other industries. The NMWQCC regulations contain requirements for cleanup of any groundwater contamination detected under discharge plan monitoring requirements. Until such cleanup is complete, these facilities may impact the availability of water supplies of sufficient quality for intended uses. Details indicating the status, waste type, and treatment for individual discharge plans can be obtained from the NMED Ground Water Bureau website (http://www.nmenv.state.nm.us/gwb/). A summary list of current discharge plans in the planning region is provided in Table 5-10; their locations are shown in Figure 5-14.

No sites in the planning region are listed by the U.S. EPA (2014) as Superfund sites. Therefore, this region does not include Table 5-11.

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 NMED 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 Estancia Basin 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 (http://www.nmenv.state.nm.us/ust/ustbtop.html).

Landfills used for disposal of municipal and industrial solid waste can 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 two operating landfills and four closed landfills (Table 5-13, Figure 5-14).

5.4.2 Nonpoint Sources

As noted above, 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.

Some communities in the west side of the basin (the East Mountain area) have reported septic tank contamination, although only one thus far (Chilili) has reported nitrate concentrations that exceed maximum contaminant levels. In the future, nitrate contamination associated with septic tanks will likely be more of a problem in areas of shallow groundwater or thinly covered fractured bedrock in the Estancia Basin, particularly if septic tank density in the basin increases.

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. In the Estancia Basin region, the Estancia Basin Water Planning Committee has identified the need for a water quality monitoring project within the planning region to protect the existing aquifer water supply from contamination and water quality deterioration. During the 2010 planning process, the Committee conceptualized development and implementation of such a program (EBWPC and HR, 2010) targeting areas of known or potential contamination. Water quality data are being collected by Sandia National Laboratories in a variety of locations within the Estancia Basin in order to provide a four-dimensional picture of water quality and water levels within the Estancia Basin (EBWPC and HR, 2010). Bernalillo

County has also initiated quarterly water level monitoring and annual water quality sampling at five locations in the western Estancia Basin (eastern Bernalillo County) (EBWPC and HR, 2010).

5.5 Administrative Water Supply

The *Updated Regional Water Planning Handbook* (NMISC, 2013) 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.

To assess the available water supply, the common technical approach considers legal and physical constraints on the supply and a range of conditions from severe drought to normal supply. The method to estimate this supply, hereafter referred to as *administrative water supply*, is based on recent diversions, which provide a measure of supply that considers both physical supply and legal restrictions (i.e., the diversion is physically available, permitted, and in compliance with water rights policies) and thus reflects the amount of water that can actually be used by a region. The recent diversion data are also corrected to reflect drought supplies, as discussed in Section 5.5.2.

5.5.1 2010 and 2060 Administrative Water Supply

The total diversions (i.e., administrative water supply) in 2010 for the Estancia Basin region, as reported by Longworth et al. (2013), were 84,129 acre-feet. Of this total, 60 acre-feet were surface water diversions (from stock ponds for livestock) and 84,069 acre-feet were groundwater. The amount of groundwater pumped from the Valley Fill in 2010 was estimated to be 77,531 ac-ft/yr, and the amount from other formations was 6,538. The breakdown of these diversions among the various sectors of use detailed in the NMOSE water use report is discussed in Section 6.1.

In mined basins such as the Estancia Basin, where the aquifer is depleted, the administrative water supply may not be sustainable in the future. The future available supply was estimated using two methods, as described in the following subsections.

5.5.1.1 Model Predicted Decline

Non-stream connected groundwater basins with available NMOSE administrative models were used to predict the water level declines in the year 2060 based on estimated groundwater diversions (Table 5-14a). For the Estancia declared OSE administrative groundwater basin, the Valley Fill, has been modeled by OSE for administration of the mined basin. The water level declines in the Valley Fill and the calculated available water column in wells were used to estimate the future administrative supply as outlined in Table 5-14a. The predicted drawdown in 2060 from a model cell in a heavily stressed area was selected and compared to the available water column in existing wells to calculate the percentage of wells impacted by the drawdown. This percentage of impacted wells was assumed to reflect a percentage reduction in available supply.

Using this method, the administrative supply in the Estancia Basin in 2060 was calculated to be 58,328 ac-ft/yr from the valley fill, plus 6,538 ac-ft/yr from other aquifers and 60 ac-ft/yr from surface water for a total of 64,926 in a normal (i.e., no drought) year.

5.5.1.2 Observed Rate of Decline

Another method to predict the future decline of the saturated thickness and thus available supply is to use existing wells with water level hydrographs and compare the predicted decline with the available water column in existing wells. Using the average rate of water level decline calculated from USGS monitor wells within the non-stream connected groundwater and assuming this rate would continue until 2060, the water level decline was predicted as shown in Table 5-14b. The percentage of impacted wells was estimated by comparing the predicted drawdown to the available water column in existing wells, and the percentage of impacted wells was assumed to represent the reduction in supply by 2060.

The predicted water level decline in the Estancia Basin Valley Fill is 61.5 feet in 2060, assuming the average water level decline rate of 1.23 ft/yr (Table 5-14b). A decline of 61.5 feet would impact about 24 percent of the wells. Assuming that the 24 percent of impacted wells results in a proportional impact on water supply, then the estimated supply in 2060 from the Valley Fill is 58,714 acre-feet per year, which is within 1 percent of the model-estimated method.

5.5.1.3 Other Considerations

Both of these approaches represent an approximation of the reduction in administrative supply by 2060. Factors that may affect the accuracy of these predictions include:

- The water columns may not represent the available supply because existing wells could possibly be drilled deeper.
- The shallowest wells that are most impacted may not proportionally represent the distribution of pumping (the deeper wells most likely pump more than the shallow wells).

- New wells could be drilled in other parts of the aquifer.

Ideally, the aquifer should be modeled to determine a sustainable rate or lifetime that is desired by the regions and to estimate the best distribution of pumping.

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. To estimate the vulnerability of the closed basins within a planning region to a prolonged drought, groundwater models are used, where available, to predict the potential impact by 2060 of a 20-year drought.

As discussed in Section 5.1.1, 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 Estancia Basin region, the PDSI classifications for 2010 were near normal (Climate Divisions 5 and 6) (Figure 5-6).

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 has developed and applied a method for regions with both stream-connected and non-stream-connected aquifers. The method adopted for non-stream connected aquifers is described below:

- The drought correction is applied only to the portion of the administrative water supply that derives water from the mined aquifer and to the minor amount of surface water use.
- In basins for which NMOSE has an administrative model, the simulation period is from 2010 to 2060 as described above, with no recharge from 2020 to 2040.
- For a conservative approximation, the drawdown predicted during the drought period is derived from a model cell in a heavily stressed area at the end of the simulation period (2060) to represent the water column that will be lost due to drought and pumping (Table 5-15).
- This adjusted predicted drawdown is then compared to the median available water column in 2010 (as described in Sections 5.5.1.1) to determine the percentage of wells that are impacted by the 20-year drought and continued pumping.
- This percentage represents the reduction in supply due to drought. The drought supply will be estimated by multiplying the percentage by the 2060 administrative supply.

The estimated reduction in administrative supply due to continued pumping and one 20-year drought with no recharge over the 50-year planning period is 47 percent, resulting in an available water supply for the Valley Fill of 41,400 ac-ft/yr. In the Valley Fill, the adjusted predicted drawdown without the drought is 63 feet, and the additional drawdown due to drought is 55 feet, for a total decline of 118 feet. Comparing the predicted drawdown during a drought to the available water column of 127 feet shows that 47 percent of wells would be impacted. Thus the water supply in 2060 is estimated to be 47 percent less than the 2010 water use or 41,400 ac-ft/yr in the Valley Fill aquifer. This estimate includes only the Valley Fill aquifer; the other aquifers were not analyzed. The total supply for the Estancia Basin in 2060 after enduring a 20-year drought is about 47,900 ac-ft/yr. The 60 acre-feet of surface water diversions throughout the planning region are assumed to be zero for the drought scenario.

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 an evaluation of current water use by sector (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).

6.1 Present Uses

The most recent assessment of water use in the region was compiled by OSE for 2010, as discussed in Section 5.5. The OSE Water Use 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 Figure 6-1. The predominant water use in 2010 in the Estancia Basin region was for irrigated agriculture.

Groundwater accounts for more than 99 percent of the total withdrawals in the region, most of which are for irrigated agriculture. Groundwater also supplies nearly all public water supply, domestic, livestock, and commercial uses. Groundwater points of diversion are shown in Figure 6-2.

The categories included in the OSE Water Use Report and shown on Figure 6-1 and Table 6-1 represent the major demands in the planning region. The OSE report does not quantify additional categories of water demand, including riparian evapotranspiration and instream flow; with the exception of evaporation of groundwater from playa lakes, these categories do not represent a significant consumption of water in the Estancia Basin planning region.

- Evaporation from playa lakes is a significant component of the water budget of the Estancia Valley; estimates include 50,000 ac-ft/yr (Smith, 1957), 27,000 to 36,000 ac-ft/yr (DeBrine, 1971), and 12,700 acre-feet per year in 1975 (Sorensen, 1977). As groundwater levels decline, discharge to the playa lakes decline as well, resulting in a decrease in evaporation.

In addition to the special conditions listed above, the 2010 NMOSE data are available for diversions 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 diversion data for planning purposes will add a margin of safety; thus the use of diversion 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 total population of Torrance County was 15,717 (U.S. Census Bureau, 2014a). No reliable figures for the portions of Torrance County, Santa Fe County, and Bernalillo County in Estancia Basin are available for 2013. The Torrance County population declined slightly over the previous 13 years (Table 3-1a).

As noted in Table 3-1d, cattle, calves, and corn for silage are the most valuable agricultural commodities in Torrance County. A land use map was included in the accepted water plan and there have not been substantial changes.

Specific information regarding the population and economic trends in each county is provided in Sections 6.2.1 through 6.2.3. 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 three 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 Santa Fe County

The southwestern area of Santa Fe County that is within the Estancia Basin Water Planning Region had a population of 10,014 in 2010 (UNM, 2014). The area has approximately 20,000 acres of irrigated agriculture.

The town of Edgewood is the main population center of this area. It is 20 miles east of Albuquerque and has become a popular bedroom community for commuters. The town's population grew 97 percent between 2000 and 2010, from 1,893 to 3,735 (U.S. Census Bureau, 2014c). The population grew to 3,779 in 2012 (City-data.com, 2014). Most of the new growth is a result of annexation, which now extends into Bernalillo County.

The town's close proximity to I-40 makes it attractive to developers and retailers. New retail stores have recently opened in the community, including the new Walmart SuperCenter has drawn shoppers from Moriarty. The population of the town could increase another 3,500 by the end of 2015 because of additional annexation, but the population of the Estancia Basin Water Planning Region will not increase as a result of the annexations because this population already resides within the region.

6.2.2 Bernalillo County

The small part of Bernalillo County in the Estancia Basin Water Planning Region, less than 10 percent of the county, is predominantly rural residential, served by domestic wells. A small number of livestock are raised here.

6.2.3 Torrance County

The total population of Torrance County (in both the Estancia Basin and Middle Rio Grande Water Planning Regions) declined from 16,911 in 2000 to 16,383 in 2010, and to 15,717 in 2013. The decline can be attributed to the lack of a diversified economy, which resulted in out-migration. After 2010, the drought also contributed. No new subdivisions have been built in many years, and new building permits average less than ten a year.

In 2012 there were 589 farms and ranches in Torrance County, a slight increase over 2007, and the number of acres increased as well, by 4 percent. Of the 589 farms, 379 reported a net loss in 2012, and 307 had sales of less than $2,500 (USDA NASS, 2014). The number of farms participating in agricultural support programs increased from 72 in 2007 to 163 in 2012 and the amount paid per farm increased from $8,353 to $19,991. According to the agriculture census

(USDA NASS, 2014), irrigated acreage decreased by 16.5 percent, from 29,942 acres in 2007 to 25,015 acres in 2012. The average age of a producer in the county increased from 61 years in 2007 to 63.5 years in 2012, and there were only 42 producers under 45 years of age (USDA NASS, 2014).

A contributing factor to the downturn in farming is increasing energy costs, as farmers have to run their well pumps for longer periods of time because of the declining water table. Increased water demand during drought in the County exacerbates the lowering of the water table and thus the potential for some private wells to go dry. Corn silage and alfalfa are the main crops. Ranchers have already sold off much of their herds, and are not likely to replenish them until the cost of feed decreases and the price for breeding heifers decreases.

The school-age population has been declining for the past few years as persons of childbearing age leave the county. Two elementary schools in the Moriarty-Edgewood School District closed in 2014.

Education and healthcare provide the largest number of non-farm jobs, with retail trade ranking second.

In 2014, Google purchased Titan Aerospace, an aerial drone manufacturer based in Moriarty. Google plans to build a 60,000-square foot facility at the municipal airport. Titan Aerospace employs about 30 individuals currently, but that number will double shortly and increase more over the next five years, perhaps to as high as 500 jobs as drone production ramps up. In the next year, Google will hire more than 100 employees; many positions will be temporary or part-time. The increase in jobs will not necessarily increase the population because those with the required professional and engineering skills are expected to commute from the Albuquerque area, 40 miles away.

Water availability may become a problem in the future because some municipal wells have required replacement.

Commercial activity in Moriarty is found along Historic Route 66. Traffic comes from I-40, which runs parallel to Route 66. Businesses are mostly travel-related—gas stations, restaurants, motels, and truck stop/travel centers. The town's retail variety store closed recently because many people go to Edgewood to shop.

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 2040 using data and historical trends from 1960 through to the 2000 Census. The Estancia Basin Water Planning Committee (EBWPC) and HydroResolutions, LLC (HR) prepared the *Estancia Basin Regional Water Plan Year 2010 Update,* relying on population data prepared by the BBER in 2008. The EBWPC and

HR projection for 2010 of a population of 37,709 residents exceeded the actual population of 32,694.

Since 2010, the drought, the national recession that started in 2007, and an inability to attract jobs to the area have resulted in population losses in Torrance County. While the Google drone factory will add a substantial number of jobs in Torrance County, many of the people who are qualified for those jobs do not live in the County.

For the population projections through 2060 (Table 6-3), two population forecasts were developed: one based on a slightly optimistic view of the economy for this region over the long-term and one that portrays a more pessimistic picture. The BBER population projections through 2040 (Appendix 6-B) were used as a starting point for the high population projections in Torrance County. For the portion of Santa Fe County in the Estancia Basin, a more recent report regarding population estimates and forecasts for Santa Fe County (UNM, 2014) was relied upon. The low population projections for the region incorporate factors that have been affecting New Mexico since 2000, including drought, continuing recession, job losses, and most recently, out-migration, especially of younger residents.

The population projections are detailed in Table 6-3 and summarized by county below:

- *Torrance County:* The population of Torrance County is projected to decline in the low growth scenario but to grow in the high growth scenario. The low growth scenario anticipates that the highly skilled employees required to fill the new jobs anticipated will commute from elsewhere. The high scenario is based on the 2012 BBER forecast and reflects an improvement in both the residential and employment situation, mainly as a result of the planned Google drone manufacturing facility in Moriarty that will employ several hundred persons. Even in the high scenario, it is not expected that the most highly skilled workers will live in the Moriarty area, but there will be an opportunity for more retail businesses to serve the new workforce. Furthermore, complementary businesses such as aircraft repair firms may follow. The northern part of Torrance County may become more of a bedroom community as a less expensive residential alternative to surrounding counties.

- *Santa Fe County:* Population growth is projected in the high scenario through 2050 and in the low scenario through 2030; from that time forward it will start to decline in the low scenario as population becomes more centralized in the Santa Fe urban area. The southern portion of Santa Fe County, mainly Edgewood, is a bedroom community for both Albuquerque and Santa Fe, and may become one for Torrance County as well when the Google plant ramps up.

- *Bernalillo County:* The population of Bernalillo County within the Estancia Basin Water Planning Region is projected to increase modestly in both the high and low scenarios.

This is primarily a residential area with little economic activity. It may serve as a bedroom community for skilled jobs in Moriarty.

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 our limited water resources. In support of that commitment, the NMOSE, when evaluating water rights transfers or 40-year water development plans that hold water rights for future use, considers whether adequate conservation measures are in place. 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 sector for developing water demand projections is discussed below. Specific recommendations for conservation programs and policies for the Estancia Basin 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 demand in each county by the following amounts:

- For current average per capita use greater than 300 gpcd, assume a reduction in future per capita demand to 180 gpcd.

- For current average per capita use between 200 and 300 gpcd, assume a reduction in future per capita demand to 150 gpcd.
- For current average per capita use between 130 and 200 gpcd, assume a reduction in future per capita demand to 130 gpcd.
- For current average per capita use less than 130 gpcd, no reduction in future per capita demand is assumed.

For the Estancia Basin region, current per capita use in Santa Fe and Bernalillo counties is under 130 gpcd (Table 6-4), so no additional conservation is assumed. Torrance 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. 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. Most pre-2002 wells are not metered, unless they serve multiple homes, 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 overall water balance in the region.

Irrigation withdrawals include both consumptive and non-consumptive uses and incidental losses:

- Consumptive uses are permanently removed from the stream system and are due to a crop's potential for evapotranspiration (i.e., evaporation and transpiration), which is determined by factors that include crop variety, soil type, climate and growing season, on-farm management, and irrigation practices.
- Additional water is used non-consumptively for conveyance requirements and is returned to the surface or groundwater system from which it was withdrawn without loss.
- Incidental losses are permanently removed from the stream system and occur through both seepage and evapotranspiration during conveyance through the irrigation system.

- Seepage losses occur when water leaks through the conveyance channel or below the root zone after application to the field but does not return to the shallow groundwater or stream system.
- 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 and ultimately within a stream system. These efforts can result in economic benefits, such as increased crop yield, but have the adverse effect of reducing return flows. For example, drip irrigation and center pivots may reduce the amount of water diverted, but due to the increased efficiency of application, it actually increases consumptive use.

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 Estancia Basin 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, but in the Estancia Basin region it is zero due to the absence of reservoirs in the region. However, there is evaporation from the playas and areas where the groundwater levels are shallow.

6.5 Projections of Future Water Demand for the Planning Horizon

To develop projections of future water demand a consistent method was used statewide, as described in Section 6.5.1. The discussion in Section 6.5.1 is a comprehensive one that includes the methods applied consistently throughout the state to project water demand in all the categories reported in the NMOSE *Water Use by Categories* reports, and some of the categories may not be applicable to the Estancia Basin region. The projections of future water demand determined using this consistent method, as applicable, for the Estancia Basin region are discussed in Section 6.5.2.

6.5.1 Water Demand Projection Methods

The *Updated Regional Water Planning Handbook* (NMISC, 2013) 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 diversions in each of the nine categories included in the 2010 OSE *Water Use by Categories* (Longworth et al., 2013) report 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 an estimate of the amount of water use in a recent year that considers physical and legal limitations. 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 (i.e., if water were to be available, there is demand and it would be applied to beneficial use). For example, some water right holders may not have put all their rights to beneficial use in some years due to drought or economic conditions. However, as water becomes available in future wet years or the economic climate improves, these existing rights may once again be exercised. Therefore, for planning purposes, it is assumed that existing rights, reflected in the administrative water supply, will be exercised by the owner when needed or may be leased to other users.

The assumptions and methods used statewide to develop the projections for each category follow. Not all of these categories are applicable to every planning region. The specific methods applied in the Estancia Basin 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 2010 Water Use report (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 demand.

In counties where a decline in population is anticipated (in either the high or low scenario or both), it was assumed that public water supply would continue at 2010 rates. 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. Water rights used for public water supply have value and are not likely to be lost through forfeiture or abandonment proceedings; therefore, constant use is assumed even as population declines slightly, as public water suppliers may serve additional customers through annexation or regionalization, or because communities outside the municipal boundaries will request service from the municipal system.

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 2010 Water Use report, 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 as aquifers go dry.

In much of the state, recent drought and recession are thought to be driving a decline in agricultural production. However, that does not necessarily indicate that there is less demand for water. In parts of the state where the irrigation is supplied by surface water, there are frequent supply limitations, with many ditches having no or limited supply later in the season.

In regions that use surface water for agriculture withdrawals, the 2010 administrative 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 demand for both the high and low scenarios.

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). However, a reduction in demand does not mean additional water would be available for appropriation. Additionally, the Estancia UWB was closed to new groundwater appropriations by order of the State Engineer in 2001. 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. Even in areas where the data indicate a decline in the agricultural economy, the high projection assumes that overall water uses will remain at 2010 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 amount, based on the assumption that water rights applied to beneficial use would have value and would continue to be used, even though there are economic declines. 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, based on the assumption that if the water is put to beneficial use in the future it will continue to have value and will be used even if there are later economic declines. 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. No reservoirs of this size exist in the planning region. 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.

6.5.2 Estancia Basin Projected Water Demand

Table 6-5 summarizes the projections for each water use category for each of the three counties that were developed by applying the methods discussed in Section 6.5.1. As discussed in Section 6.3, population is projected to increase under the high projections in all three counties, except for a decline in Santa Fe County after 2050 only. For the low growth scenario, population is projected to decline slightly in Torrance County, increase slightly in Santa Fe County through 2030 and then decline, and increase slightly in Bernalillo County.

Demand in the *public water supply* category is projected to increase in all three counties under the high scenario, proportional to the increasing population projections. However, use in this category is not projected to decline proportionally to the low projections for Torrance and Santa Fe counties indicating declining population, because as discussed in Section 6.5.1, the water suppliers retain their water rights via NMSA 1978, Section 72-1-9, and, for planning purposes, it is assumed that use in the public water supply category will remain at 2010 levels (in Torrance County) or 2030 levels (in Santa Fe County).

Projected water demand in the *commercial* and *domestic* categories is assumed to be proportional to the population growth rates, which are anticipated to increase except in Santa Fe and Torrance counties, where a slight decrease is projected under the low scenario for all or some of the future decades. The low projections for Torrance County assume current levels of use for the domestic and commercial categories, and for Santa Fe County, a higher value is projected in 2030 and is assumed to be maintained for decades 2040 through 2060.

The current observed declining trend in *agricultural* water use is expected to continue for the short-term; for the low projection purposes this is assumed to be through 2020 with agriculture beginning to recover by 2030. However, a reduction in demand does not mean additional water would available for appropriation, as the agricultural center of the water planning region has been closed to new appropriations since 2001. Additionally, though water rights transfers in the Estancia UWB are constrained by OSE guidelines (NMOSE, 2002), as demand shifts over time, transfers from agriculture to other water use sectors may occur through sales and leases. Even in areas where the data indicate a decline in the agricultural economy, the high projection assumes that overall water uses will remain at 2010 levels since water rights have economic value and will continue to be used.

For the high scenario, the demand for water devoted to irrigated agriculture in Torrance County is projected to remain at the 2010 level throughout the projection period (regardless of the actual availability of water) to illustrate the potential gap between supply and demand. For the low scenario, an initial steep decline is projected with a gradual rebound to 80 percent of the 2010 level by 2050, remaining steady at that level through 2060.

In Santa Fe County the amount of water devoted to irrigated agriculture is projected to remain stable at the 2010 level through 2060 in the high scenario, but to reach only 90 percent of that level by 2060 in the low scenario.

No irrigated agriculture exists in the Bernalillo County portion of Estancia Basin.

The *livestock* category in Torrance County is expected to recover to 90 percent of 2010 levels by 2060 in the high projection, but to only 80 percent in the low projection. In this scenario, some ranches will go out of business because younger people, who do not view ranching as a desirable or economically viable career choice, will not replace the older generation of ranchers. Similar trends are expected for livestock water use in the portions of Santa Fe and Bernalillo counties within the planning region.

None of the counties within the region have any significant *industrial*, *mining*, or *power generation* activity, and based on the interviews conducted, no growth is expected in the mining and power sectors. A slight increase in the industrial category for Torrance County is anticipated.

The *reservoir evaporation* category is included for statewide accounting, but has little bearing on the supply available to the Estancia Basin region. The Estancia Basin region projections include no water demand in the reservoir evaporation category due to lack of any reservoir greater than 5,000 acre-feet within the planning area. However, various researchers estimated evaporation of groundwater from playa lakes within the planning region to be approximately 50,000 ac-ft/yr (Smith, 1957), 27,000 to 36,000 (DeBrine, 1971), and 12,700 in 1975 (Sorensen, 1977).

7. Identified Gaps between Supply and Demand (Prepared by State)

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

- 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 4, there are considerable legal limitations on the development of water supplies in the Estancia Basin. The basin is closed to new water rights appropriations, other than domestic and livestock wells, which affects the ability of the region to prepare for shortages by developing new supplies within the region and no other source of supply are available.

- 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-corrected water supply. Future water demand projections do not reflect substantial growth in water use (Figure 7-1), due to the declining economy discussed in Sections 3 and 6. The future water supply is represented as declining based on the predicted impact to the Estancia Basin Valley Fill if the aquifer continues to decline at current rates (Figure 7-1, Table 7-1). Comparing the projected demands to the future supply following a prolonged drought shows a range of water shortages between 22,000 and 37,000 acre-feet in 2060. However, water management strategies to mitigate the impacts of diminishing groundwater supplies are high priorities for the region (EBWPC and HR, 2010); thus the rate of decline may change to enhance the life of the aquifer.

8. Implementation of Strategies to Meet Future Water Demand (Prepared by the Regions)

8.1 Water Conservation

8.2 Implementation of Strategies Identified in Previously Accepted Regional Water Plan

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

8.4 Evaluations

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