
CITY OF LAS CRUCES 40-YEAR WATER DEVELOPMENT PLAN

by

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EXECUTIVE SUMMARY

The City of Las Cruces is in the Mesilla Basin along the Rio Grande, and extends into the West Mesa area on the edge of the Mesilla Basin, and into the East Mesa area in the southern part of the Jornada del Muerto Basin (Fig. 1). The Mesilla Basin and Jornada del Muerto Basin represent two sub-basins within the Lower Rio Grande Basin. The City relies on groundwater from its Valley and West Mesa Well Fields in the Mesilla Basin, and East Mesa Well Field in the Jornada del Muerto Basin, for its potable water supply (Fig. 2). The groundwater supply is produced from the Quaternary-age river valley alluvium, and the thick, unconsolidated Quaternary- to Tertiary-age Upper and Middle Santa Fe Group basin-fill sediments (Fig. 3).

Wastewater is treated at the City's Jacob A. Hands wastewater treatment facility, East Mesa water reclamation facility, and West Mesa wastewater treatment plant (Fig. 2). The Jacob A. Hands wastewater treatment facility also receives wastewater from other water systems in the Mesilla and Jornada del Muerto Basins, and the East Mesa water reclamation facility also receives wastewater from other water systems in the Jornada del Muerto Basin. Treated effluent from the Jacob A. Hands wastewater treatment facility is discharged as return flow to the Rio Grande. The East Mesa water reclamation facility produces very high quality reclaimed (Class A) water for landscape irrigation, and the West Mesa wastewater treatment plant produces reclaimed water used for sprinkler-irrigation of native vegetation in the West Mesa Industrial Park.

Groundwater diversions for Las Cruces Utilities water supply represent only 6.5 percent of total metered groundwater diversions in the Lower Rio Grande Basin (Fig. 4; NMOSE, 2016a; NMOSE, 2016b; 2011 to 2015 average). The majority of groundwater diversions are for irrigated agriculture, at about 84 percent of total metered groundwater diversions. In terms of both groundwater and surface water demand, groundwater diversions for Las Cruces water supply represent only 4.5 percent of the total water demand in the Lower Rio Grande water planning region (NMISC, 2016; 2010 data). If Las Cruces' return flow to the Rio Grande is considered, then Las Cruces water supply represents only 2.6 percent of the total regional water demand.

Moreover, the City's priority date of 1905 for its LRG-430 *et al.* water rights is both pre-Project and pre-Rio Grande Compact, thus providing it with the right to affect surface flows of the Rio Grande.

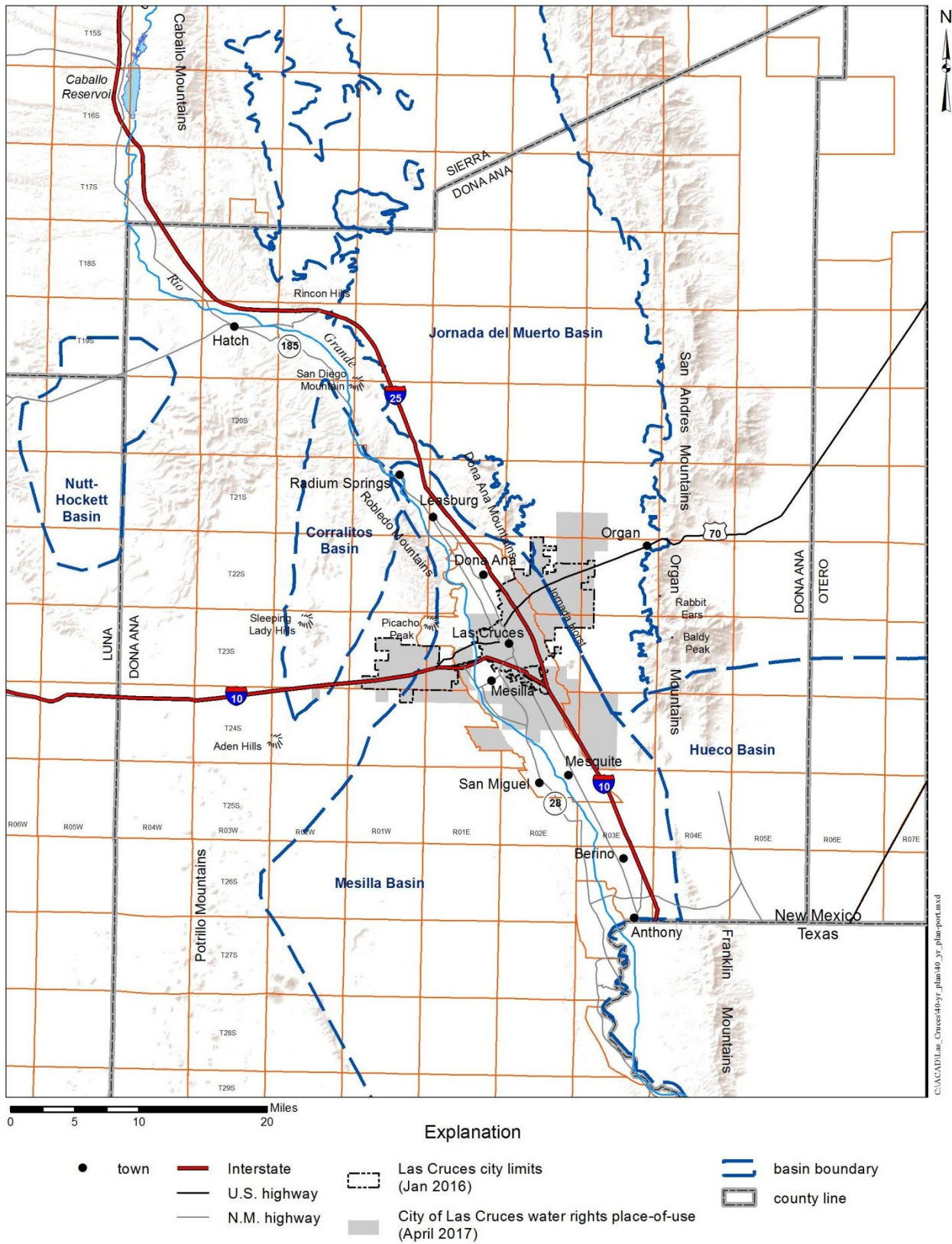


Figure 1. Map of the Mesilla Basin and southern part of the Jornada del Muerto Basin showing City of Las Cruces.

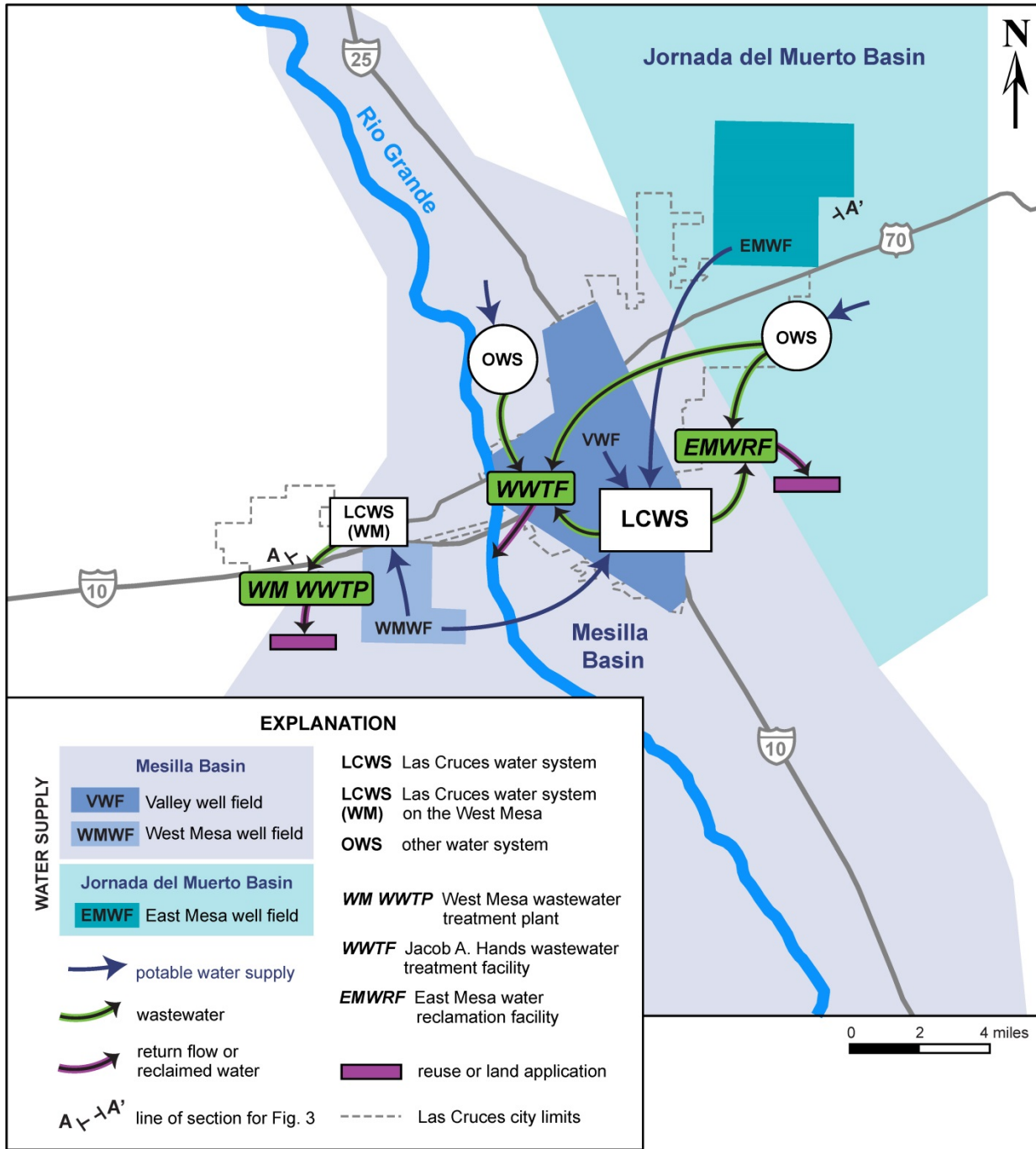


Figure 2. Schematic illustration of City of Las Cruces water supply, and water and wastewater system.

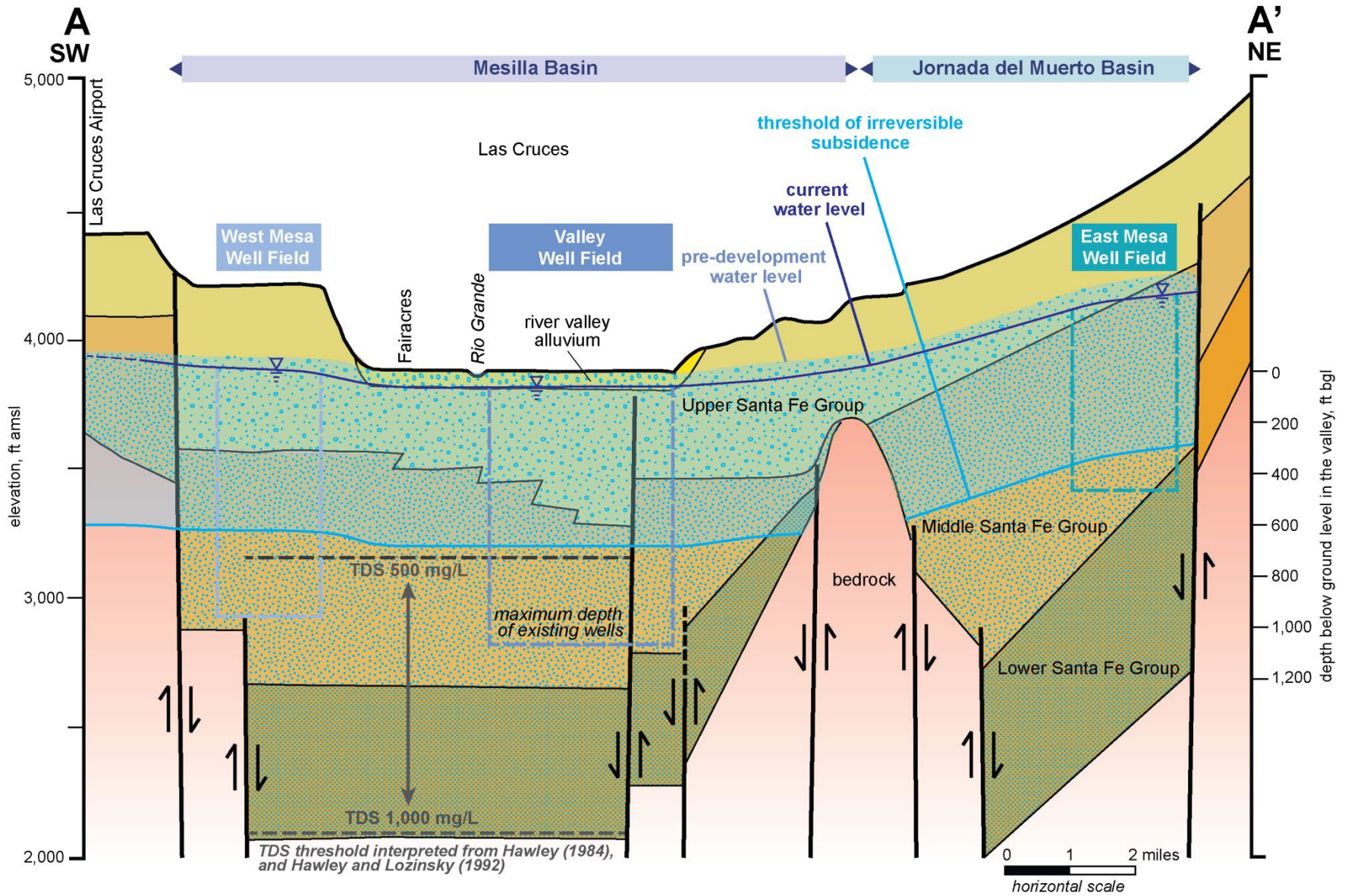


Figure 3. Schematic southwest-to-northeast hydrogeologic cross-section of City of Las Cruces area, after Hawley and Kennedy (2004).

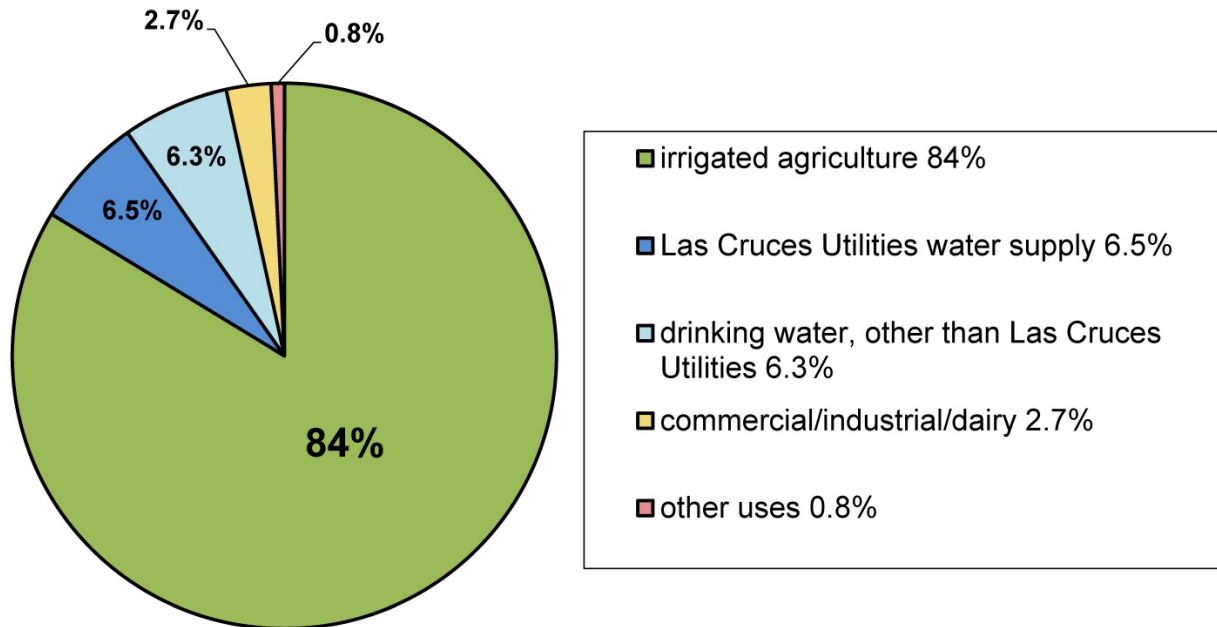


Figure 4. Chart summarizing groundwater diversions in the Lower Rio Grande Basin, 2011 to 2015.

Implementation of the City’s water development plan will benefit the people of Las Cruces by providing a safe and reliable water supply while limiting water waste, optimizing efficiency of water use, preventing pollution of water supply, and remediating contaminated groundwater. The City’s water development plan is consistent with the following principles defined by consensus by the National Groundwater Association (NGWA):

- “Groundwater sustainability: The development and use of groundwater resources to meet current and future beneficial uses without causing unacceptable environmental or socioeconomic consequences.”
- “Resilience: The capacity of a groundwater (or water-resources) system to withstand either short-term “shocks” (e.g., drought) or long-term change (e.g., climate change). When discussing resilience, the timeframe under consideration should be defined. Resilience applies to both water quantity and quality and may be an important concept as part of groundwater sustainability.”
- “Adaptive management: A staged decision-making approach to long-term groundwater (water-resources) management with an aim to reducing uncertainty over time via system monitoring.”

Las Cruces Utilities (LCU) will develop and maintain a sustainable water supply for City of Las Cruces over the next 40 years by:

- Using existing groundwater rights and permits in the Mesilla Basin and Jornada del Muerto Basin
- Developing thresholds for water quality and quantity, beyond which alternate water supply must be developed
- Developing an alternate water supply
- Practicing proactive conservation
- Monitoring water resources

Las Cruces' principal goal is to continue to beneficially use its existing water rights from its LRG-430 et al. well field and to perfect and beneficially use the water rights from its East Mesa and West Mesa well fields and to protect its right to do so in court proceedings and in its interaction with other water users in the Lower Rio Grande Water Users' Organization.

Development of an alternate supply is necessary due to water-level declines, and the transition to groundwater pumping from storage. Groundwater pumping from storage, also referred to as groundwater mining, is occurring in the shallow part of the aquifer in the Mesilla Basin due to a shortage of surface water and increased pumping for irrigated agriculture. A shortage of surface water also has implications for the City's ability to use return flow to meet streamflow offset requirements associated with groundwater permits, due to conditions on the use of return flow associated with the City's LRG-430 et al. water right. Thus, development of an alternate water supply is generally based on physical limitations, as opposed to deficiency in the amount of existing water rights and permits.

Water-level trends in the Mesilla Basin and the southern Jornada del Muerto Basin are being monitored under the City's water-level monitoring program. Water-level declines must be managed in order to avoid eventual irreversible subsidence and compaction of the aquifer, which would result in diminished capacity for aquifer recharge. Water-level declines may also be accompanied by a decrease in groundwater quality. Thus, the timing of development and implementation of alternate supply will be based on the threshold of irreversible subsidence, water quality thresholds, and appropriate warning indicators, within and beyond the 40-year planning timeframe. Figure 3 illustrates the threshold of irreversible subsidence as defined for the Mesilla Basin and Jornada del Muerto Basin. The need to consider alternate supplies may also be triggered by legal constraints arising from *Texas v. New Mexico & Colorado*, Original No. 141.

Importation of groundwater, aquifer storage and recovery with reclaimed water, and development of deep brackish-water wells and desalination, have been identified as potential sources for alternate supply. Sources for importation evaluated for potential implementation within the 40-year planning period include groundwater from the Corralitos Basin, Nutt-Hockett Basin, Mimbres Basin, or Salt Basin. These potential sources of alternate supply are considered in this Plan, and would need to be reviewed by the New Mexico Office of the State Engineer prior to determination of a policy direction from the LCU Board.

PROJECTED GROWTH

Las Cruces' low- and medium-growth population projections are referenced from City planning documents; the high-growth projection of 2.4-percent annual growth reflects historical average growth. Planning according to the historical average rate will allow LCU to perfect the water rights in the place-of-use area. However, LCU recognizes that there is some overlap with areas served by other utilities and place-of-use of water rights from other utilities, such as Moongate Water Company. Considering high growth and water conservation, the demand served by LCU would increase to 44,207 acre-feet per year (ac-ft/yr) by 2055.

WATER CONSERVATION GOALS

Las Cruces has and continues to refine the implementation and practice of its Water Conservation Program. Las Cruces is implementing its Water Conservation Program proactively and systematically, and in a manner appropriate to the conditions and needs of the community. The City is utilizing the highest and best technology available and economically feasible for the intended use to ensure conservation of water to the maximum extent practical. It may not be possible to meet the City's water demands by conservation alone, in the case that current and future activities in the Lower Rio Grande Basin pose challenges to using existing rights and permits to meet demand.

Las Cruces' goals for gallons per capita day (GPCD) water use will be met by the continued practice of the Water Conservation Program. Las Cruces has the goal of reducing total GPCD water use to 140 GPCD by 2055, by reducing single-family residential GPCD, working with industrial, commercial, and institutional customers, conservation at City facilities, and by reducing non-revenue water to 9 percent of diversions. It should be noted that this GPCD goal does not yet apply to customers of the former Jornada Water Company, recently acquired by LCU; water use data for the former Jornada Water Company are currently inadequate to determine a realistic GPCD goal for these customers.

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- Appendix A. LRG-430 Subfile Order
- Appendix B. LRG-3283 through LRG-3285 and LRG-3288 through LRG-3296
East Mesa Permits
- Appendix C. LRG-3275 et al. West Mesa Permit
- Appendix D. Background on Surface-Water Resources
- Appendix E. Background Hydrogeology of the Mesilla Basin
- Appendix F. Background Hydrogeology of the Jornada del Muerto Basin
- Appendix G. Existing Wells
- Appendix H. Return Flow Plan
- Appendix I. LRG-389 and LRG-399 Permit Approval and Water Rights Transfers
- Appendix J. LRG-5818 et al. Permit, Southwest Environmental Center Water Use
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- Appendix K. LRG-5039 et al. Permit
- Appendix L. NMOSE GPCD Calculator Spreadsheet, version 2-05, with Las Cruces
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- Appendix M. Climate
- Appendix N. Water Distribution/Production Standard Operating Procedure on Hydrants
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- Appendix O. Drought and Water Emergency Response Plan
- Appendix P. Water Conservation Ordinance, water rates, and Water Conservation Plan
- Appendix Q. LRG-47 et al., LRG-48 et al., LRG-50 et al., LRG-1882 et al., and
LRG-4278 Permits

**CITY OF LAS CRUCES
40-YEAR WATER DEVELOPMENT PLAN**

1.0 WATER-SUPPLY DEVELOPMENT PLAN

1.1 Introduction

The City of Las Cruces is in the Mesilla Basin along the Rio Grande, and extends into the West Mesa area on the edge of the Mesilla Basin, and into the East Mesa area in the southern part of the Jornada del Muerto Basin. The City relies on groundwater from its Valley and West Mesa Well Fields in the Mesilla Basin, and well fields on the East Mesa in the Jornada del Muerto Basin, for its potable water supply. Figure 5 shows the City's existing wells. Wastewater is treated at the City's Jacob A. Hands wastewater treatment facility, East Mesa water reclamation facility, and West Mesa wastewater treatment plant. Treated effluent from the Jacob A. Hands wastewater treatment facility is discharged as return flow to the Rio Grande.

Groundwater diversions for Las Cruces water supply represent only 6.5 percent of total metered groundwater diversions in the Lower Rio Grande Basin (see Fig. 4; NMOSE, 2016a; NMOSE, 2016b; 2011 to 2015 average). In terms of both groundwater and surface water demand, groundwater diversions for Las Cruces water supply represents only 4.5 percent of the total water demand in the Lower Rio Grande water planning region (NMISC, 2016; 2010 data). If Las Cruces' return flow to the Rio Grande is considered, then Las Cruces water supply represents only 2.6 percent of the total regional water demand. Moreover, the City's priority date of 1905 for its LRG-430 *et al.* water rights is both pre-Project and pre-Rio Grande Compact, thus providing it with the right to affect surface flows of the Rio Grande.

Las Cruces 40-year water development plan has been prepared by John Shomaker & Associates, Inc. (JSAI) under the supervision of Las Cruces Utilities (LCU), and Utilities Director, Dr. Jorge Garcia. Implementation of the water development plan will benefit the people of Las Cruces by providing a safe and reliable water supply for residential, institutional, commercial, industrial, and recreational uses, and firefighting. The plan also aims to limit water waste, optimize efficiency of water use, prevent pollution of water supplies, and remediate contaminated groundwater.

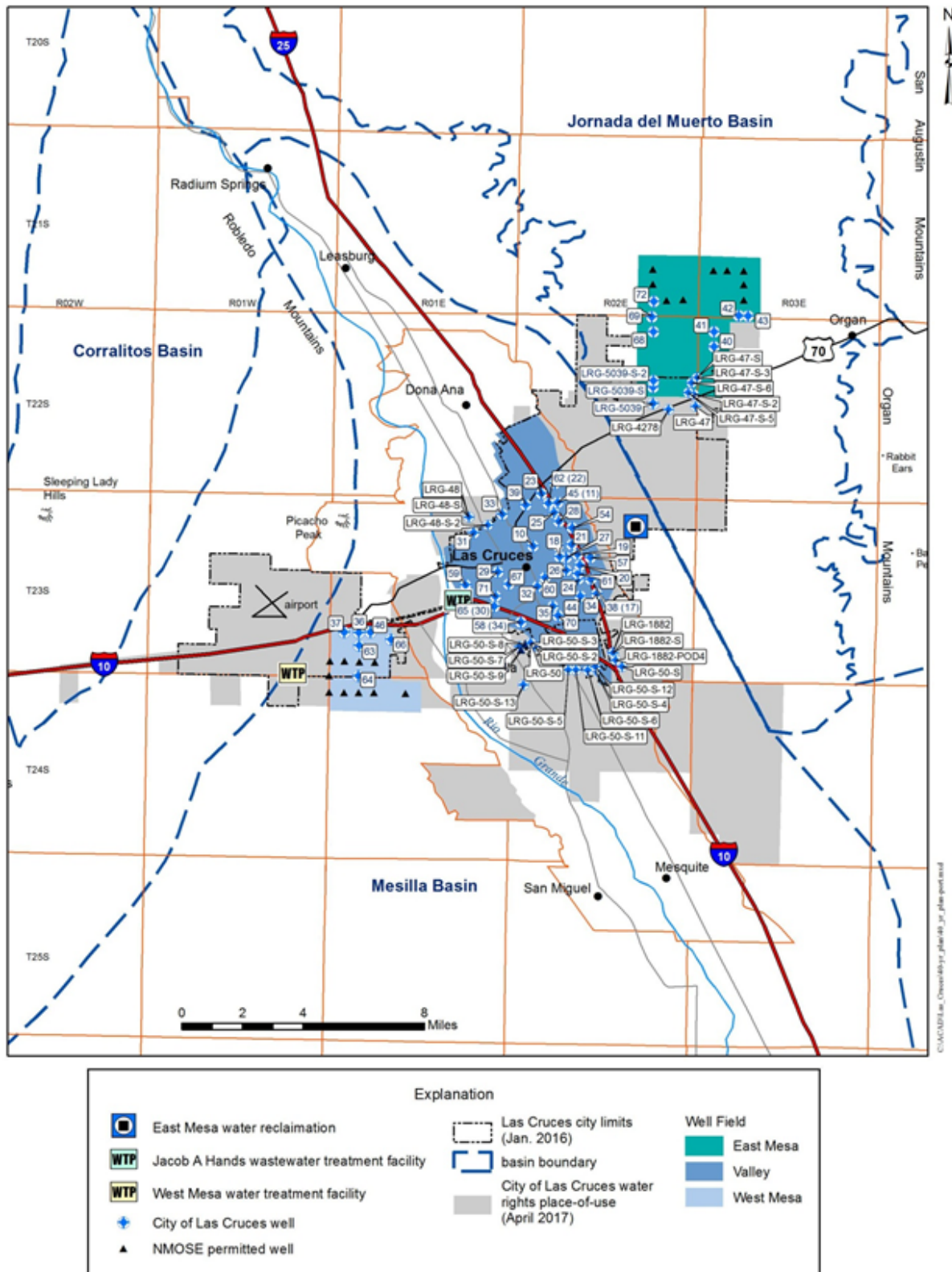


Figure 5. Map of City of Las Cruces area showing the East Mesa, West Mesa, and Valley Well Fields, and existing wells and permitted well locations.

1.2 Develop Alternate Supply

Las Cruces Utilities (LCU) will develop and maintain a sustainable water supply for the City of Las Cruces over the next 40 years by developing an alternate water supply in addition to using existing groundwater rights and permits. Development of an alternate water supply is generally based on physical limitations and potential legal/administrative constraints, as opposed to deficiency in the amount of existing water rights and permits. Potential legal/administrative constraints may arise from the general stream system adjudication or *Texas v. New Mexico and Colorado*, Original No. 141. Development of an alternate supply is necessary due to water-level declines in the Mesilla and Jornada del Muerto Basins, and the transition to groundwater pumping from storage. Groundwater pumping from storage, also referred to as groundwater mining, is occurring in the shallow part of the aquifer in the Mesilla Basin due to a shortage of surface water and increased pumping for irrigated agriculture.

A shortage of surface water also has implications for the City's ability to use return flow to meet streamflow offset requirements associated with groundwater permits, due to conditions on the use of return flow associated with the City's LRG-430 et al. water right. Return flow associated with LRG-430 et al. cannot be consumptively used, or used to fulfill offset requirements associated with other permits, when Elephant Butte Irrigation District's (EBID's) surface-water irrigation allotment is less than 2 acre-feet per acre. The City's existing portfolio of groundwater rights and permits is intended to be used in combination, with depletions from pumping under the West Mesa permit offset by return flows associated with the LRG-430 et al. right and the East Mesa permits (Appendices A, B, and C). If return flows from LRG-430 et al. cannot be used for offsets, or if LRG-430 et al. and East Mesa pumping must be curtailed due to water-level declines, this poses challenges to using existing rights and permits to meet demand.

Water-level trends in the Mesilla Basin and the southern Jornada del Muerto Basin are being monitored under the City's water-level monitoring program, and declines must be managed in order to avoid eventual irreversible subsidence and aquifer compaction, which would result in diminished capacity for aquifer recharge. Water-level declines may also be accompanied by a decrease in groundwater quality. There is evidence for accelerating water-level declines in the Jornada del Muerto Basin, as can be expected as a result of pumping and low-permeability boundaries within the aquifer. In the Mesilla Basin, inactive City supply wells monitored by the City, and observation wells monitored by the USGS, also show declines. Some of these declines in the Mesilla Basin

appear to be accelerating in response to increased pumping for irrigated agriculture and diminished short-term recharge. Farmers will likely deepen wells in the Mesilla Basin in years to come, thereby accelerating declines in the deeper part of the aquifer in which City wells are completed. The New Mexico Universities Working Group on Water Supply Vulnerabilities (2015) indicates that “the Mesilla Valley aquifer may no longer have the capacity to provide a reliable, supplemental supply during extended drought conditions and with the current levels of intensive use of groundwater.” This statement refers to extended drought conditions such as those experienced in Las Cruces area in the 1960s, and 2009 through 2014; periods with consecutive years of below-average annual precipitation. The “current levels of intensive use of groundwater” refers to the increased pumping for irrigated agriculture in the shallow part of the aquifer in the Mesilla Basin.

1.3 Rio Grande Surface Water Will Not Be Pursued for Alternate Supply

Due to current and projected availability of surface water in the Rio Grande, LCU will not pursue efforts to develop this source as an alternate water supply at this time; any future consideration of developing this source would be contingent on a number of factors. The Upper Rio Grande Impact Assessment (BOR, 2013) indicates that supplies from all native water sources to the Rio Grande are projected to decrease by an average of about one third overall. Projections show increased variability in flows on a monthly and annual basis in the future. Climate change modeling for the region indicates earlier snowmelt runoffs and warmer average temperatures, leading to increased variability in the magnitude, timing, and spatial distribution of streamflow.

The New Mexico Universities Working Group on Water Supply Vulnerabilities (2015) indicates that the Rio Grande has in recent years exhibited earlier peak flows and diminished streamflow efficiency, defined as the volume of downstream snowmelt runoff per unit of winter precipitation. They recommend that water managers consider the full range of NRCS (Natural Resources Conservation Service) predicted flows, “in this regard we note the dismal 10% of average at the low end of the range of projected flows at San Marcial.” Appendix D provides a description of surface-water resources.

The volume of water stored in Elephant Butte Reservoir upstream of Las Cruces decreased precipitously between 2000 and 2004, is now about one-quarter of what it was between 1985 and 1999, and is projected to continue to decrease (BOR, 2013).

1.4 Potential Sources for Alternate Supply

Importation of groundwater from nearby basins, aquifer storage and recovery with reclaimed water, and development of deep brackish wells and desalination, have been identified as potential sources for alternate supply. Sources for importation evaluated for potential implementation within the 40-year planning period include groundwater from the Corralitos Basin, Nutt-Hockett Basin, Mimbres Basin, or Salt Basin (Fig. 6). The NMOSE has declared the Lower Rio Grande, Nutt-Hockett, Mimbres, and Salt Underground Water Basins; the Corralitos Basin is part of the Lower Rio Grande Underground Water Basin. Sources for alternate supply in the Corralitos Basin, Nutt-Hockett Basin, and Mimbres Basin would likely take the form of a transfer of leased or purchased water rights, whereas the source for alternate supply in the Salt Basin may take the form of a new appropriation. The New Mexico Office of the State Engineer (NMOSE) has not forbidden transfers across basin boundaries, and there are many instances in which this practice of groundwater importation is occurring. Currently, there are several pending applications before the NMOSE for major interbasin transfers.

In the sections below, potential sources for alternate supply are discussed in broad, qualitative terms of institutional constraints, technical feasibility, capital and operating costs, environmental impacts, and potential amounts of water available. This discussion is not intended to be a rigorous analysis of feasibility, but is intended to provide useful information for initial prioritization of potential sources.

1.4.1 Importation of Groundwater from the Corralitos, Nutt-Hockett, or Mimbres Basins

The Corralitos, Nutt-Hockett, and Mimbres Basins lie to the west of Las Cruces (Fig. 6). Importation of groundwater from these basins holds potential in the case that groundwater becomes available for lease or purchase within the 40-year planning period.

The Corralitos Basin is within 4 miles of Las Cruces Airport, and would therefore not require a major extension of LCU infrastructure. The Corralitos Basin contains unconsolidated sediments of the Quaternary-to-Tertiary-age Santa Fe Group, up to about 300 ft thick (JSAI, 2004). Water columns in wells typically range from 50 to 150 ft. Well yields up to 1,000 gallons per minute (gpm) have been reported. Little water quality data are available for groundwater in the Corralitos Basin; based on available data, total dissolved solids (TDS) concentrations may exceed the secondary (aesthetic-related) drinking water standard of 500 milligrams per liter (mg/L) in some wells. The Corralitos Basin is a sub-basin of the Lower Rio Grande, and groundwater flows across low-permeability boundaries of the sub-basin.

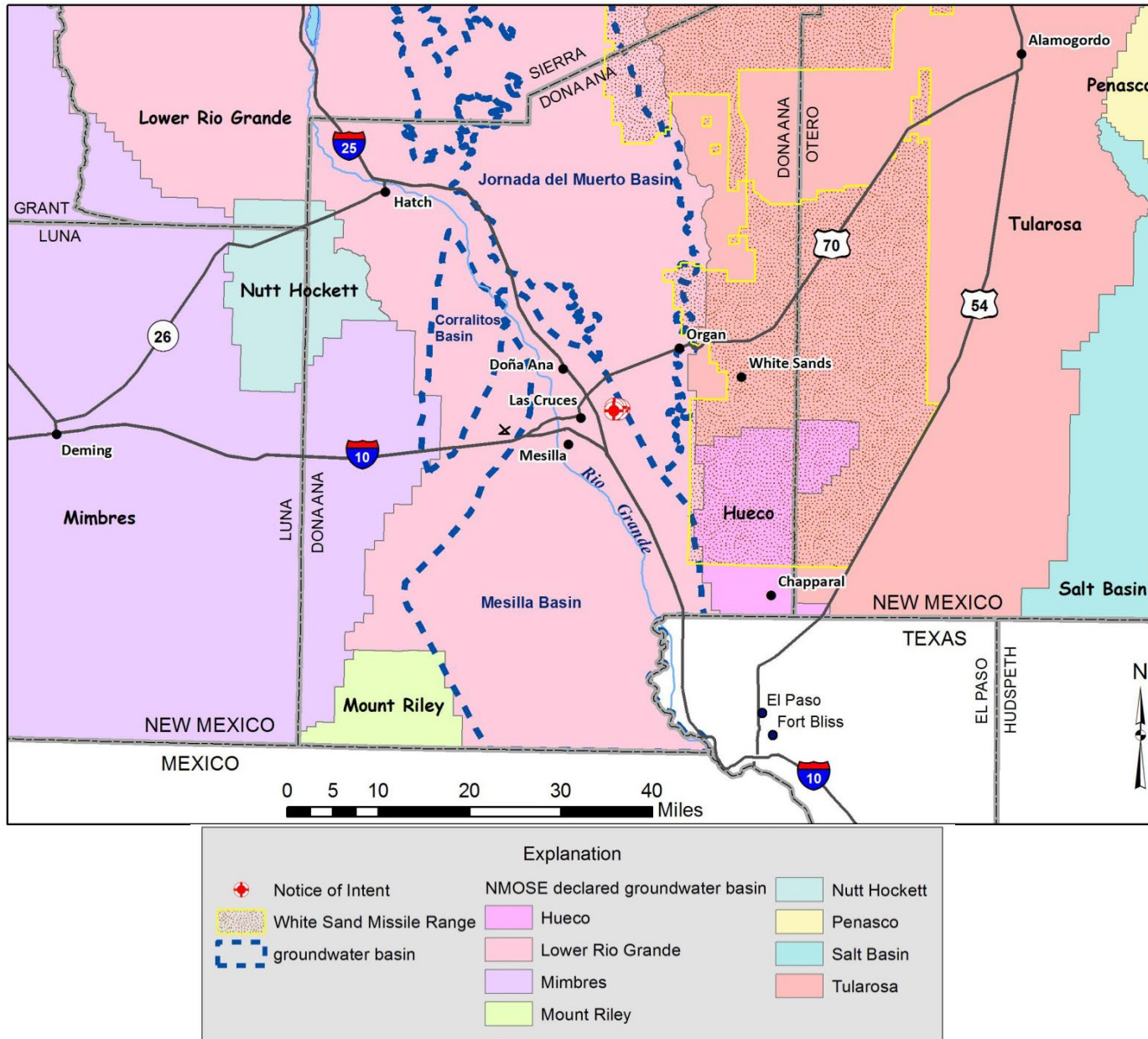


Figure 6. Map of southern New Mexico showing potential sources for alternate supply for the City of Las Cruces.

The Nutt-Hockett Basin is located about 14 miles northwest of the Corralitos Basin, and contains up to 500 ft of unconsolidated sediments of the Quaternary-to-Tertiary-age Santa Fe Group and Tertiary-age volcanic rocks (JSAI, 2004). Well yields up to 3,000 gpm have been reported. Groundwater quality is relatively good, although arsenic concentrations may be elevated above the primary drinking water standard of 0.010 mg/L in some wells. Groundwater in the Nutt-Hockett Basin generally flows to the northeast towards the Rio Grande.

The Mimbres Basin lies west of the Corralitos Basin. The basin area covers more than 4,000 square miles. Deming, New Mexico, in the central part of the Mimbres Basin, is about 50 miles west of Las Cruces. The Mimbres Basin is filled with up to 2,400 ft of poorly-consolidated sediments of the Quaternary-to-Tertiary-age Gila Conglomerate; the thickest deposits are near Deming (JSAI, 2006b). Wells for municipal use and irrigated agriculture in the Deming area yield hundreds of gpm to 1,000 gpm. Groundwater in the Gila Conglomerate aquifer in the Mimbres Basin is generally of good quality, although brackish groundwater does occur in the southeastern part of the basin, southeast of the Deming area (Hanson et al., 1994).

1.4.1.1 Institutional Constraints

As mentioned above, the NMOSE has not forbidden transfers across basin boundaries, and groundwater importation remains feasible from a water-rights permitting standpoint. Water rights permit applications for the Corralitos, Nutt-Hockett, or Mimbres Basin would likely take the form of transfer of existing groundwater rights. In the case of the Corralitos and Nutt-Hockett Basins, existing groundwater rights associated with irrigated agriculture may become available for lease or purchase, and in the case of the Mimbres Basin, existing groundwater rights associated with irrigated agriculture or mining-related industrial use may become available for lease or purchase. If groundwater rights associated with irrigated agriculture are transferred, the amount available for transfer is limited to the consumptive use (irrigated acreage multiplied by the consumptive irrigation requirement (CIR)).

From the infrastructure and right-of-way (ROW) standpoint, pipeline infrastructure would primarily cross BLM lands and State lands in the parts of the basins in Doña Ana County. There are significant areas of private lands in the parts of the Nutt-Hockett and Mimbres Basins in Luna County, to the west of Doña Ana County. The SunZia Southwest Transmission Project appears to have successfully negotiated ROW for above-ground transmission lines on BLM and

State lands, and minor areas of private lands, in Luna County in 2015. Interstate highway ROW along Interstate-10 between Las Cruces and Deming, or railroad ROW between Las Cruces and Deming and between Deming and Hatch, could potentially be utilized for pipelines from the Mimbres and Nutt-Hockett Basins.

1.4.1.2 Technical Feasibility

Insight on technical feasibility of groundwater importation via pipeline may be gained by reviewing the Eastern New Mexico Rural Water System (also referred to as the Ute Pipeline Project), a 151-mile-long proposed pipeline project designed to provide municipal and industrial water supply to several communities and Cannon Air Force Base in eastern New Mexico, a combined population of 73,000 (Widdison, 2015). Construction of this project began recently due to depletion of potable groundwater resources in the region, and it represents an example of an existing project for comparison.

Particularly applicable may be a phase of the Ute Pipeline Project referred to as the Interim Groundwater Pipeline (IGWP), designed to provide interim water supply by leasing or purchasing agricultural water rights until the project extends to Ute Reservoir, the ultimate water source for the Ute Pipeline Project. Construction of the IGWP began in 2015 with an estimated 10-year construction timeframe to supply 4,849 ac-ft/yr via a 97.5-mile pipeline, whereas the total project is to be constructed within a 25-year timeframe and supply 16,450 ac-ft/yr (ENMWUA, 2015).

Building pipeline infrastructure to the Corralitos Basin is likely the most technically feasible because the Corralitos Basin is within 4 miles of Las Cruces Airport. Building pipeline infrastructure to the Nutt-Hockett Basin would be similarly technically feasible; the Nutt-Hockett Basin is located about 14 miles northwest of the Corralitos Basin. In the case of the Corralitos Basin and Nutt-Hockett Basin, insight on technical feasibility may be gained by reviewing the development of infrastructure to convey groundwater from Las Cruces' East Mesa Well Field for municipal water supply.

1.4.1.3 Capital and Operating Costs

Insight on capital costs may be gained by reviewing the Ute Pipeline Project's IGWP. The IGWP includes about 97.5 miles of pipeline to be constructed within a 10-year timeframe to supply 4,849 ac-ft/yr. Capital costs to build the IGWP are estimated at \$105.1 million (2015 dollars; ENMWUA, 2015), or about \$1.1 million per mile when divided by 97.5 miles.

Capital costs could be significantly higher for a pipeline project that involves booster pump stations and other infrastructure considerations required by large elevation differences. The IGWP includes at least three booster pump stations across an area with relatively moderate elevation change of 600 ft. Capital costs could vary significantly depending on whether pipeline may be installed by trenching, ripping, or blasting.

Capital costs for a well field and pipeline project in the Corralitos, Nutt-Hockett, and Mimbres Basins would also include services related to well field development (in the case that well rehabilitation or replacement is needed), permitting, and system engineering and design.

Operating expenses would include energy, chemicals, labor, routine maintenance and repairs, and debt payment for capital costs of construction; other expenses such as replacements, expansions, and new technology would be minimal in the early years of project operation. Operating expenses associated with energy may be reduced in the case that renewable energy resources are developed in combination with the project, as is becoming increasingly common with new water projects.

1.4.1.4 Environmental Impacts

An Environmental Assessment would be required for a project involving federal lands, influence, funding, or agency actions, and would need to consider the impacts of the proposed action and alternatives. The Environmental Assessment would evaluate impacts on the affected environment and resources, which could include water resources, soils and geologic resources, land cover and vegetation, grazing, wildlife, cultural resources, socioeconomic resources, environmental justice, land use, energy requirements, transportation, air quality, climate change, and visual resources.

Environmental Assessment, Biological Assessment, and issuance of “Finding of No Significant Impacts” was a 3-year process in the case of the Ute Pipeline Project (Widdison, 2015). Environmental Assessment was an approximately 5-year process in the case of the SunZia Southwest Transmission Project (Scoping Report dated April 2010, U.S. Bureau of Land Management (BLM) Record of Decision (ROD) dated January 2015), and an 8-year process in the case of the Alamogordo Regional Water Supply Project (Scoping Report dated April 2005, BLM ROD dated August 2012).

1.4.1.5 Potential Amounts of Water Available

In the case of the Corralitos Basin, irrigation of 635 acres with 1,905 ac-ft/yr has been declared under NMOSE File No. LRG-468 et al. in the southeastern part of the Corralitos Basin. Relatively high transmissivities have been interpreted for the LRG-468 et al. wells, but the aquifer to the north and south of this zone appears to have lower transmissivity, indicating that high transmissivity may be localized in the basin (JSAI, 2004). Although a CIR of 1.92 ac-ft/ac was established for the water right in the 1993 temporary transfer LRG-468-A, the Rio Grande Adjudication has established a CIR of 2.6 ac-ft/ac for future transfers to non-irrigation purposes of use that shall apply to all irrigated acreage in the Lower Rio Grande. Thus, the maximum transfer associated with the water right would likely be 1,651 ac-ft/yr. It should be noted that a 2002 application to transfer 1,000 ac-ft/yr was withdrawn, possibly due to a letter from the State Land Office claiming that the water rights were appurtenant to State Trust Lands, and the applicant did not have the State Land Commissioner's consent to sever the water rights from Trust Lands.

In the case of the Nutt-Hockett Basin, the potential amounts of water available would likely be limited based on the quantity of agricultural groundwater rights that may become available for lease or purchase. Pumping for irrigated agriculture in the Nutt-Hockett Basin was estimated by the NMOSE to be 17,185 ac-ft/yr in 2010 (NMOSE, 2013), of which 13,493 ac-ft/yr was consumptively used (net pumping). The actual quantity of agricultural groundwater rights that may become available for lease or purchase would likely be significantly less than the net pumping associated with agricultural rights, as the area has a strong tradition of growing high-value crops such as chile, which will likely be preserved and continue.

In the case of the Mimbres Basin, the potential amounts of water available would likely be limited based on the quantity of agricultural groundwater rights that may become available for lease or purchase primarily in the area near Deming. Net pumping for irrigated agriculture in the Mimbres Basin in Luna County was estimated by the NMOSE to be 24,879 ac-ft/yr in 2010 (NMOSE, 2013), although a portion of that likely occurred near the New Mexico-Mexico border. The NMOSE estimated an additional 29,553 ac-ft/yr of surface water from the Mimbres River consumptively used for irrigation in Luna County in 2010.

JSAI has estimated net pumping for irrigated agriculture in the Deming area of the Mimbres Basin to range from 12,000 to 18,000 ac-ft/yr between 2006 and 2015 based on irrigated acreage evident in historical aerial photographs and a CIR of 1.80 ac-ft per acre.

In the Mimbres Basin, groundwater rights associated with mining-related industrial use may also become available for lease or purchase primarily in the area northwest of Deming, in Grant County. Pumping for mining use in Grant County was estimated by the NMOSE to be 7,882 ac-ft/yr in 2010 (NMOSE, 2013).

1.4.2 Importation of Groundwater from the Salt Basin

The Salt Basin lies to the east of Las Cruces (Fig. 6). Importation of groundwater from the Salt Basin holds potential as a joint project based on geography and major facilities in the area; the Salt Basin boundary is 35 to 40 miles from White Sands Missile Range (WSMR) Post Headquarters, which is in turn about 20 miles from Las Cruces.

The Salt Basin is one of the few remaining groundwater basins in New Mexico that contains large undeveloped areas, and groundwater recharge to the basin has been estimated at about 60,000 ac-ft/yr (JSAI, 2010). The Salt Basin spans about 5,095 square miles and straddles the New Mexico-Texas border, with about 43 percent of the basin area in New Mexico and 57 percent of the basin area in Texas. The Salt Basin aquifer is composed of carbonate rocks and alluvium-filled structural basins. The alluvium and fractured and karstified carbonate rocks have high permeability, and are surrounded by lower permeability bedrock. The majority of pumping in the basin has occurred close to the New Mexico-Texas border near Dell City, Texas. The New Mexico State Engineer declared the Salt Underground Water Basin in 2002 in an effort to regulate development by investors planning to import water from the Salt Basin to the El Paso metropolitan area.

1.4.2.1 Institutional Constraints

As mentioned above, the NMOSE has not forbidden transfers across basin boundaries, and groundwater importation remains feasible from a water rights permitting standpoint. Water rights permit applications for the Salt Basin may take the form of a new appropriation of groundwater. The New Mexico Interstate Stream Commission (NMISC) has filed applications to appropriate 90,000 ac-ft/yr based on the NMISC's interest in reserving the groundwater resource for potential future development for meeting interstate compact obligations on the Rio Grande and the Pecos River, or for use by New Mexico communities (Widdison, 2013). Importation of groundwater from the Salt Basin by Las Cruces would potentially be aligned with the NMISC's interests and the intent

of their existing application, as Las Cruces' treated effluent is discharged as return flow to the Rio Grande, and Las Cruces' water sources in the Lower Rio Grande would be replaced with the Salt Basin source.

From the infrastructure and ROW standpoint, pipeline infrastructure would primarily cross federal lands, and would involve cooperation from agencies including WSMR (U.S. Army). An example of a similar ROW project is the SunZia Southwest Transmission Project, the 2015 approval of which was contingent on burial of segments of transmission lines in order to mitigate impacts to military operations at WSMR.

1.4.2.2 Technical Feasibility

Insight on technical feasibility of groundwater importation via pipeline may be gained by reviewing the Ute Pipeline Project's Interim Groundwater Pipeline (IGWP), as discussed above in Section 1.4.1.2. Construction of the IGWP began in 2015 due to depletion of potable groundwater resources in the region, and it represents an example of an existing project for comparison.

1.4.2.3 Capital and Operating Costs

Insight on capital costs may be gained by reviewing the Ute Pipeline Project's IGWP, as discussed above in Section 1.4.1.3. Capital costs for a Salt Basin well field and pipeline project would also include services related to well field development, permitting, and system engineering and design.

Operating expenses would include energy, chemicals, labor, routine maintenance and repairs, and debt payment for capital costs of construction; other expenses such as replacements, expansions, and new technology would be minimal in the early years of project operation. Operating expenses associated with energy may be reduced in the case that renewable energy resources are developed in combination with the project, as is becoming increasingly common with new water projects.

1.4.2.4 Environmental Impacts

As discussed above in Section 1.4.1.4, an Environmental Assessment would be required for a project involving federal lands, influence, funding, or agency actions, and would need to consider the impacts of the proposed action and alternatives. Environmental Assessment, Biological Assessment, and issuance of "Finding of No Significant Impacts" for this type of project would likely be a three- to 8-year process.

1.4.2.5 Potential Amounts of Water Available

Groundwater recharge to the Salt Basin has been estimated at 60,000 ac-ft/yr, with about 87 percent of recharge in the New Mexico part of the basin and about 13 percent of recharge in Texas (JSAI, 2010). Recharge to the Salt Basin occurs by direct infiltration of precipitation in areas at higher elevations and areas of fractured rock, and infiltration of storm-water runoff into drainage channels, including the Sacramento River drainage, and alluvial fans. This estimate of 60,000 ac-ft/yr is in general agreement with a number of studies that present estimates ranging from about 55,000 to 100,000 ac-ft/yr (Bjorklund, 1957; Ashworth, 1995; Mayer, 1995; JSAI, 2002; Hutchison, 2008; DBSA, 2010). A recent study presents a much lower estimate of 6,000 to 12,000 ac-ft/yr based on environmental tracers (Sigstedt et al., 2016), but the discrepancy between this estimate and earlier estimates is unclear and the study does not include a discussion of their estimate in the context of the hydrogeologic conceptual model and basin water balance established by previous studies, or water-level trends. The range of water-availability estimates are bracketed on the high end by the estimated maximum sustainable yield of 150,000 ac-ft/yr (Livingston Associates, 2002).

The majority of pumping in the basin has occurred in the Texas part of the basin near Dell City, Texas. Net pumping was estimated at 89,000 ac-ft/yr, on average, between 1948 and 2009 (JSAI, 2010; this estimate is considered to be somewhat high). Net pumping in the New Mexico part of the basin has been estimated by the NMOSE to range from 1,580 and 10,130 ac-ft/yr between 1980 and 2010 (NMOSE *New Mexico water use by categories* series technical reports, e.g., NMOSE, 2013). The NMISC has applied to the NMOSE to appropriate a total of 90,000 ac-ft/yr from three applications (Widdison, 2013). The applications remain pending, and have received protests.

1.4.3 Aquifer Storage and Recovery with Reclaimed Water

The East Mesa water reclamation facility is used to collect wastewater from interceptors serving the East Mesa, High Range, and Sonoma Ranch areas, and produces very high quality reclaimed water for landscape irrigation, dust suppression, and supply to purple hydrants for fire suppression (Fig. 5). Important customers include the Sonoma Ranch Golf Course, Veteran's Park, Sagecrest Park, the closed Foothills Landfill, the City compost operation, Las Cruces Dam Environmental Restoration Project, and Centennial High School. Peak summer demand from the facility is about 700,000 gallons per day; however, the facility must ramp down in winter when there is very little demand for the water. The City has permits to discharge to a nearby arroyo, but that has been found to be unpopular with the public and is therefore not considered a practicable

option. Ramping down the facility each year poses operational issues, as the treatment system functions best with relatively consistent flow, as opposed to large seasonal fluctuations. Thus, reclaimed water produced from the East Mesa water reclamation facility during the winter represents a source that is not fully utilized and is a potential source for alternate supply.

LCU would like to utilize this source for alternate supply through an aquifer storage and recovery (ASR) project with well injection. Several City wells are located in close proximity to the reclaimed water pipeline, and could potentially be converted to injection wells. However, the current regulatory environment poses major challenges that may prohibit such a project. Treating the water to be injected to drinking-water quality, as would probably be required, is cost-prohibitive for LCU at this time. LCU is open to exploring other levels of treatment, with cooperation and support from regulatory agencies; for example, treatment that would decrease nitrate concentrations might be sufficient. LCU may also explore options for permitting disposal wells that would allow for injection, and applying to the NMOSE for potential return flow credit.

1.4.3.1 Institutional Constraints

New Mexico State agencies have regulatory processes for ASR and injection wells, and several ASR projects are in progress in New Mexico. Although the current regulatory environment poses permitting challenges, as ASR projects gain momentum in New Mexico and elsewhere in the U.S., regulations may be reviewed and modified for a more streamlined process and variances based on hydrogeologic conditions.

1.4.3.2 Technical Feasibility

The technical feasibility of ASR depends on aquifer characteristics, and the capacity of the aquifer to store water at the proposed ASR project site. In general, the technical feasibility of ASR using injection wells in appropriate areas has been demonstrated by projects in the U.S. and abroad. The Mesilla Basin and Jornada del Muerto Basins have been recognized as having excellent potential for ASR (Hawley, 2016).

1.4.3.3 Capital and Operating Costs

Capital costs may include modification of existing wells or completion of new wells as injection wells. Capital costs would also include services related to permitting, and system engineering, design, and testing. The capital costs of an ASR project with reclaimed water may be the lowest overall capital costs among the potential sources for alternate supply discussed in Section 1.4 of this Plan. Factors increasing capital costs of an ASR project would include the need to complete new wells, and the need to treat water to be injected, to drinking-water quality.

1.4.3.4 Environmental Impacts

In the case of ASR and injection wells, the primary focus of environmental impacts assessment would likely be assessment of impacts on groundwater in the project area. Disturbance of the landscape would be minimal compared to the groundwater importation and pipeline projects discussed in the sections above, and the project may be executed wholly on City-owned lands.

1.4.3.5 Potential Amounts of Water Available

The East Mesa water reclamation facility has a capacity of 1,000,000 gallons per day (about 1,121 ac-ft/yr). Average water reuse diversions for the winter months November through March represent about 58 percent of average water reuse diversions for the summer months April through October (2011 to 2015 data), and reflect the lack of demand for reclaimed water during the winter months. Under-utilization of the facility in the winter months equates to about 340 ac-ft/yr, based on data from 2011 to 2015. Thus, the potential amounts of water from an ASR project based on current capacity of the East Mesa water reclamation facility are relatively small compared to potential amounts of water available from groundwater importation projects discussed in the sections above.

1.4.4 Deep Brackish Wells and Desalination

Deep brackish groundwater resources where the top of the aquifer is more than 2,500 ft deep and the water has total dissolved solids (TDS) concentrations in excess of 1,000 milligrams per liter, represent a potential source for alternate supply (JSAI, 2008). Las Cruces filed Notice of Intent (NOI) for an estimated 5,000 ac-ft/yr of production from selected locations on City-owned lands on the East Mesa prior to passage of legislation in 2009 in which NMSA 72-12-25 was amended to give the State Engineer jurisdiction over these resources for municipal supply (Fig. 6). A technical memorandum prepared by Daniel B. Stephens & Associates, Inc. (DBSA, 2015) evaluates desalination, the process of physically removing dissolved solids from water for potable consumption, in Las Cruces.

Major limitations to developing deep brackish wells and a desalination project include the costs to drill and complete deep wells, to pump water from great depth, and to build, operate, and maintain a desalination treatment plant, and dispose of brine concentrate. The cost of constructing a deep well may be more than \$500 per foot. Operation and maintenance for a desalination plant would potentially increase the cost to produce drinking water by three to five times (DBSA, 2015).

Concerns unique to inland desalination projects include uncertainty regarding the magnitude of the resource, issues relating to water treatment for constituents in groundwater such as silica, and disposal of brine concentrate (Thomson, 2016). If brine concentrate is to be disposed of via deep well injection instead of evaporation ponds, there are major costs associated with permitting, construction, testing, and operation of injection well(s), and construction of infrastructure to convey concentrate to the injection well(s). Pipeline construction materials costs alone would be significant, as materials must be able to withstand highly-corrosive brine concentrate. It is possible that the water treatment cost component could decrease in the future, if membrane technology becomes cheaper, but significant costs related to permitting, construction, materials, and operation and maintenance would remain.

Due to the significant costs associated with developing deep brackish-water wells and a desalination project, this alternative is ranked as the last potential source for alternate supply within the 40-year planning period, after groundwater importation.

1.4.4.1 Institutional Constraints

In order to minimize the potential for institutional constraints, the City filed NOIs for locations on City-owned lands prior to passage of legislation in 2009 in which NMSA 72-12-25 was amended to give the State Engineer jurisdiction over these resources for municipal supply.

1.4.4.2 Technical Feasibility

The technical feasibility of deep brackish wells and desalination in appropriate areas has generally been demonstrated by projects in the U.S. and abroad. Within relatively close proximity to Las Cruces, the joint desalination facility operated by El Paso Water Utilities and Fort Bliss represents the world's largest inland desalination plant.

Technical feasibility is particularly complex for inland desalination projects in which the magnitude of the resource is uncertain, water treatment must address constituents in groundwater such as silica, and disposal of concentrate is a major issue.

1.4.4.3 Water Quality

TDS concentrations for the target deep aquifer may range from 1,500 to 7,500 mg/L due to water-rock interactions (JSAI, 2008). Sulfate concentrations may be high due to dissolution of gypsum, and concentrations of dissolved metals may be high due to high heat flow, volcanic rocks, and mineralization in the area. As mentioned above, water treatment for silica in groundwater is another concern unique to inland desalination projects.

1.4.4.4 Capital and Operating Costs

Capital costs would include completion of new deep brackish wells and possibly injection wells depending on the method chosen for disposal of brine concentrate, and construction of a desalination treatment plant. Las Cruces' NOI on the East Mesa considers five wells, each completed to a depth of 5,000 to 6,000 ft. As mentioned above, the cost of constructing a deep well may be more than \$500 per foot, and possibly as high as \$1,000 per foot. Capital costs would also include services related to permitting, and system engineering, design, and testing.

Operating costs associated with deep brackish wells and desalination would likely represent the highest operating costs among the potential sources for alternate supply discussed in Section 1.4 of this Plan. Operating costs would include costs to pump water from great depth, operate and maintain a desalination treatment plant, and dispose of brine concentrate, in addition to operating costs common to other groundwater projects, such as energy, chemicals, labor, routine maintenance and repairs, and debt payment for capital costs of construction.

1.4.4.5 Environmental Impacts

In the case of deep brackish wells and desalination, the primary focus of environmental impacts assessment would likely be assessment of impacts on groundwater and surface water in the region. The lateral extent of disturbance of the landscape would be less than the disturbance created by the groundwater importation and pipeline projects discussed in the sections above, and the project may be executed wholly on City-owned lands. If evaporation ponds are the method chosen for disposal of brine concentrate, environmental impacts assessment associated with air quality, wildlife, and the potential for contamination of the vadose zone, groundwater, and the land surface, would be significant.

1.4.4.6 Potential Amounts of Water Available

Las Cruces' NOI on the East Mesa includes an estimate of total production of 5,000 ac-ft/yr. The joint desalination facility operated by El Paso Water Utilities and Fort Bliss has the capacity to produce up to 27.5 million gallons of fresh water per day (about 30,825 ac-ft/yr), which likely represents the current upper limit on capacity of a state-of-the-art inland desalination facility.

1.5 Timeline for Implementation of Alternate Supply

The timeline for implementation of an alternate supply will likely be based on a threshold related to physical supply, such as a drawdown threshold not to be exceeded due to potential for irreversible subsidence and aquifer compaction. A water quality threshold would also need to be considered; as water-level declines may be accompanied by a decrease in groundwater quality, to the point that water treatment may be necessary for the existing supply. There is also a possibility that the threshold may take the form of a water-resources management threshold, as discussed in Section 2.11.

1.5.1 Drawdown Threshold

The maximum drawdown threshold, or threshold of irreversible subsidence, has been established for Las Cruces based on the method presented by Heywood (1992), which is based on the difference between present elevations in the Rio Grande Valley and bordering mesa areas. This difference is representative of the net overburden removed by the cycle of erosion and re-aggradation between the mid-Pleistocene and Holocene. The change in effective stress is estimated to occur at a calculated freshwater hydraulic head decline of [1.2 times the thickness of eroded overburden]. At Las Cruces, this thickness is based on the elevation change between the airport on the West Mesa at an elevation of about 4,450 ft above mean sea level (amsl), and Fairacres (North Fairacres Road) at an elevation of about 3,900 ft amsl, or about 550 ft. Multiplied by 1.2, the change in effective stress would occur at a decline of 660 ft from pre-development heads for Las Cruces water supply wells in the Valley of the Mesilla Basin (Fig. 3).

The change in effective stress could occur at a significantly lower decline on the East and West Mesas, as Heywood (1992) notes, “the preconsolidation stress threshold for overlying late Pleistocene or Holocene fluvial sediments and Bolson sediments outside the Rio Grande Valley may be significantly lower as it is for analogous sediments elsewhere (Holzer, 1981).”

1.5.2 Drawdown Warning Indicator

A drawdown warning indicator should be developed in order to ensure protection of the aquifer in the case that the drawdown threshold is approached, and to trigger actions towards alternate supply. Las Cruces’ water-level monitoring program, described in Section 2.9, will provide the data to indicate whether the drawdown threshold is being approached. A drawdown

warning indicator could be defined based on trends or changes observed in the water-level monitoring dataset, such as:

- Increase in 5- or 10-year running average water-level decline rate, such that the decline rate, if sustained, would lead to water-level declines approaching the drawdown threshold near the end of the 40-year planning period.
- Acceleration of the rate of water-level decline, such that the acceleration rate, if sustained, would lead to water-level declines approaching the drawdown threshold near the end of the 40-year planning period.

The drawdown warning indicator may require a certain level of statistical significance or confidence to avoid a false indication due to variance or noise in the dataset. The drawdown warning indicator may require that trends or changes be observed in a certain number of wells, or a specific set of wells designated as sentinel wells or representative of a substantial part of the total water supply.

The period of record for Las Cruces' water-level monitoring program is now long enough that long-term water-level trends are emerging for the majority of wells included in the program (JSAI, 2016); however, another 5 or 10 years of continued monitoring may be required to achieve the statistical significance required for a drawdown warning indicator.

1.5.3 Water Quality Threshold

Groundwater-level declines approaching the drawdown threshold may be accompanied by a decrease in groundwater quality. At the point that the quality of the existing supply has deteriorated to the point that treatment is needed, it may become more practical to implement an alternate supply. In terms of total dissolved solids (TDS), although the secondary (aesthetic-related) drinking water standard is 500 mg/L, the threshold would likely be closer to 1,000 mg/L. Existing Las Cruces water-supply wells typically produce water with TDS concentrations ranging from 300 to 500 mg/L, with occasional TDS results as high as 900 mg/L. TDS concentration of 1,000 mg/L typically represents the lower limit of waters defined as "brackish." The drawdown threshold will likely be reached prior to the TDS threshold in Las Cruces area of the Mesilla Basin (see Fig. 3); therefore it may be more reasonable to tie the water-quality threshold to a constituent other than TDS.

The TDS threshold is a major issue of discussion in the Mesilla Basin south of Las Cruces, near the border with Texas and Mexico. By some estimates, a TDS threshold may be reached within 10 to 15 years in that area. Other estimates indicate that there is enough fresh water to meet demand for the next two decades in that area (Albuquerque Journal Editorial Board, 2016). Due to the TDS threshold issue in the region, it is important to consider development of alternate supply with deep brackish wells and desalination for long-range planning, even though such a project may currently have a low ranking in terms of potential alternate supply due to associated costs (see Section 1.4.4, above). In a recent article discussing groundwater development in the Mesilla Basin, the manager of EBID made reference to the “West Mesa aquifer” containing “50 million acre-feet of economically extractable water, less brackish than the water being extracted in east El Paso” (LeCompte, 2016). It is unclear what potential undeveloped groundwater resource is being referred to as the “West Mesa aquifer” in the article, in terms of location and depth, but it does not appear to coincide with the City’s West Mesa Well Field as described in this Plan.

The water-quality threshold may also be tied to concentrations of naturally-occurring uranium in groundwater in Las Cruces area of the Mesilla Basin. Seven City wells in the Mesilla Valley (Wells 10, 19, 20, 21, 24, 38, and 44) are not currently in service due to elevated naturally-occurring uranium concentrations in groundwater. The primary drinking water standard for total uranium is 30 micrograms per liter, which would represent the threshold beyond which water treatment is needed.

1.5.4 Groundwater Level Declines

Decline from pre-development heads is on the order of 40 to 50 ft, and current rates of decline are on the order of 1 to 2 ft/yr, for Las Cruces wells in the Valley of the Mesilla Basin, based on pre-development heads as presented in JSAI (2006a) and recent water levels (JSAI, 2016). Appendix E presents hydrographs for selected wells in the Mesilla Basin. Rates of decline appear to be accelerating in a number of wells in the Mesilla Basin (e.g., Figs. E12, E14, E16, E17, E21, and E22); 2 ft/yr would be expected to represent the minimum rate of decline for future projections. However, we do not have a good way to estimate future decline rates if the water table becomes disconnected from the river in areas of heavy pumping, especially where there is little irrigation, as is the case for some Las Cruces wells in the Valley. Thus, rates of decline for future projections could be significantly greater than 2 ft/yr.

Decline from pre-development heads is currently on the order of 60 to 70 ft, and current rates of decline are on the order of 3 to 4 ft/yr, for Las Cruces wells in the Jornada del Muerto Basin, based on pre-development heads as presented in JSAI (1996) and recent water levels (JSAI, 2016). Appendix F presents hydrographs for selected wells in the Jornada del Muerto Basin. Rates of decline appear to be accelerating in wells in the Jornada del Muerto Basin (e.g., Figs. F5 through F7); thus 4 ft/yr would be expected to represent the minimum rate of decline for future projections.

1.6 Planning for Several Possible Future Scenarios

The water-supply development plan must allow LCU the flexibility to meet current and future demand under several potential future scenarios, including:

- Groundwater use will be subject to the implications of the 2008 Operating Agreement among U.S. Bureau of Reclamation (BOR), Elephant Butte Irrigation District (EBID), and El Paso County Water Improvement District No. 1 (EPCWID). This scenario will likely lead to increased pumping of supplemental irrigation wells, and accelerated drawdowns, which may affect pumping of Las Cruces wells close to the Rio Grande and result in more pumping in the Jornada del Muerto Basin.
- Groundwater use will not be affected by the Operating Agreement, but will be subjected to conventional administration by NMOSE. Under this scenario, the City's preference is to pump from the Mesilla Basin.
- Management of the river and groundwater that is hydrologically connected to the river will be "federalized," and the City will be required to enter into a contract with BOR to continue to divert groundwater in the Lower Rio Grande Basin.

These potential future scenarios are discussed in detail in Section 2.11.

2.0 WATER RIGHTS AND WELLS

Las Cruces has well fields in the Mesilla Basin (Fig. 5; Valley and West Mesa Well Fields) and the southern Jornada del Muerto Basin (Fig. 5; East Mesa Well Field), from which groundwater is produced under the terms of NMOSE Permit No. LRG-430 et al., which represents a groundwater right of 21,869 ac-ft/yr with a priority date of 1905.

In the Mesilla Basin, Las Cruces also has permits to develop groundwater rights of 5,042 ac-ft/yr (LRG-389, LRG-399, and LRG-5818 et al.) in the Valley, and 8,000 ac-ft/yr on the West Mesa (West Mesa permit LRG-3275 et al.). In the Jornada del Muerto Basin, Las Cruces has permits to develop a groundwater right of 10,200 ac-ft/yr (East Mesa permits LRG-3283 through LRG-3285 and LRG-3288 through LRG-3296) and permits to develop groundwater rights of 107 ac-ft/yr (LRG-5039 et al.). Las Cruces recently acquired Jornada Water Company with permits to develop a groundwater right of 5,961 ac-ft/yr in the Mesilla and Jornada del Muerto Basins (LRG-47 et al., LRG-48 et al., LRG-50 et al., LRG-1882 et al., and LRG-4278).

In addition to groundwater rights, the City currently owns or leases about 1,412 acres of surface-water rights in EBID. A full annual surface-water allotment from EBID is 3 ac-ft/ac, but the allotment depends on flows in the Rio Grande.

A summary of the City's current rights and permits is presented in Table 1, and a summary description of existing wells is presented in Table 2. Table 3 indicates the NMOSE well number associated with each existing and planned City well. A summary of data for existing wells is provided in Appendix G. Two of LCU's wells (Wells 18 and 27) currently in service in the Valley are operating as plume capture wells for the tetrachloroethylene (PCE) plume at the Griggs and Walnut Superfund site. Water pumped from Wells 18 and 27 is treated and stored in a tank, and the City uses the treated water for municipal water supply; treatment system operation and reporting to the U.S. Environmental Protection Agency (EPA) is being performed voluntarily until LCU has a consent decree with EPA, and represents a positive example of proactive water management. Seven wells in the Valley are not currently in service due to naturally-occurring elevated uranium concentrations in groundwater. LCU has been developing flexible infrastructure to allow for delivery of water to different parts of the water system, and east-west redundancy within the system. Implementation of enhanced meter calibration and automatic meter reading (AMR) ensures compliance with water rights and permits.

Table 1. Summary of City of Las Cruces water rights and permits

NMOSE File No.	basin	water-right status	diversion amount, ac-ft/yr
LRG-430 et al.	Mesilla/ Jornada del Muerto	pre-basin, conditional use of return flow ^a	21,869
LRG-3283 through LRG-3285, LRG-3288 through LRG-3296 East Mesa permit	Jornada del Muerto	permitted, new appropriations, minimal offsets required ^b	10,200
LRG-3275 et al. West Mesa permit	Mesilla	permitted, new appropriations, offsets required ^c	8,000
LRG-389	Mesilla	permitted, new appropriations, offsets required ^d	2,550
LRG-399	Mesilla	permitted, new appropriations, offsets required ^e	1,700
LRG-5818 et al.	Mesilla	permitted, new appropriations, offsets required ^f	792
LRG-5039 et al.	Jornada del Muerto	permitted, new appropriations, offsets required	107
LRG-47 et al., LRG-48 et al., LRG-50 et al., LRG-1882 et al., LRG-4278	Mesilla/ Jornada del Muerto	permitted, new appropriations, offsets required	5,961
groundwater rights and permits			51,179
surface water rights owned		adjudicated ^g	1,412 acres

^a In periods of drought in which EBID allotment to irrigators is less than 2 ac-ft/ac, Las Cruces is not to consumptively use treated effluent derived from LRG-430 wells, but instead must return effluent to stream system.

^b Total of 100 ac-ft/yr in offsets required after 40 years, total of 644 ac-ft/yr in offsets required after 100 years.

^c Amount of water that may be diverted re-evaluated and determined by NMOSE annually subject to any offset debt from previous calendar year(s) and anticipated availability of offsets in the current calendar year, pursuant to Return Flow Plan (JSAI, 2009).

^d The City has permit to drill well LRG-389, but the well has not been drilled due to groundwater quality issues at the permitted location.

^e 435.5 ac-ft/yr of rights already transferred into LRG-399.

^f Total diversion amount is 792 ac-ft/yr. Offsets required for diversions exceeding 42.46 ac-ft/yr (maximum beneficial use). 15 ac-ft/yr serving Southwest Environmental Center.

^g A full surface-water allotment from EBID is 3 ac-ft/ac, but the allotment depends on flows in the Rio Grande.

NMOSE - New Mexico Office of the State Engineer

EBID - Elephant Butte Irrigation District

ac-ft/yr - acre-feet per year

Table 2. Summary of existing City of Las Cruces wells

wells	well field	basin	NMOSE File No.	water-right status	diversion amount, ac-ft/yr
Wells 10, 18-21, 23-33, 35, 38, 39, 44, 45, 54, 57-62, 65, 67, 70, 71, Driving Range, Paz Park	Valley	Mesilla Basin	LRG-430 et al.	pre-basin	21,869
Wells 36, 37, 46, 63, 64	West Mesa				
Wells 42, 43	East Mesa		LRG-430 et al. ^a		
Well 40	East Mesa	Jornada del Muerto Basin	LRG-3289	permitted, new appropriations, minimal offsets required ^b	10,200
Well 41	East Mesa		LRG-3288		
Well 68	East Mesa		LRG-3290		
Well 69	East Mesa		LRG-3291		
Well 72	East Mesa		LRG-3292		
Well 71 ^d	Valley	Mesilla Basin	LRG-399	permitted, new appropriations, offsets required	1,700
Wells 66, S-4, S-6	Valley		LRG-5818 et al.	permitted, new appropriations, offsets required ^c	792
Wells LRG-5039, LRG-5039-S, LRG-5039-S-2	East Mesa	Jornada del Muerto Basin	LRG-5039 et al.	permitted, new appropriations, offsets required	106.866
Wells LRG-47 thru -47-S-6, LRG-48 thru -48-S-2, LRG-50 thru -50-S-13, LRG-1882 thru -1882-POD4, LRG-4278	East Mesa	Mesilla Basin and Jornada del Muerto Basin	LRG-47 et al., LRG-48 et al., LRG-50 et al., LRG-1882 et al., LRG-4278	permitted, new appropriations, offsets required	5,961

^a These wells to be transferred to East Mesa permit (LRG-3283 through LRG-3285, LRG-3288 through LRG-3296)

^b Total of 100 ac-ft/yr in offsets required after 40 years, total of 644 ac-ft/yr in offsets required after 100 years.

^c Total diversion amount is 792 ac-ft/yr. Offsets required for diversions exceeding 42.46 ac-ft/yr (maximum beneficial use). 15 ac-ft/yr serving Southwest Environmental Center.

^d Well 71 (LRG-430-S-44) permitted as supplemental point of diversion under LRG-399.

NMOSE - New Mexico Office of the State Engineer

ac-ft/yr - acre-feet per year

Table 3. Existing and planned City of Las Cruces wells and associated NMOSE file numbers

NMOSE Well No.	City Well No.	well field	status
LRG-430	10	Valley	not currently in service ^b
LRG-430-S	44	Valley	not currently in service ^b
LRG-430-S-2	45 (11)	Valley	not currently in service
LRG-430-S-3	58 (12, 34)	Valley	in service
LRG-430-S-4	38 (17)	Valley	not currently in service ^b
LRG-430-S-5	18	Valley	in service ^a
LRG-430-S-6	19	Valley	not currently in service ^b
LRG-430-S-7	20	Valley	not currently in service ^b
LRG-430-S-8	21	Valley	not currently in service ^b
LRG-430-S-9	62 (22)	Valley	in service
LRG-430-S-11	24	Valley	not currently in service ^b
LRG-430-S-12	26	Valley	in service
LRG-430-S-13	25	Valley	in service
LRG-430-S-14	27	Valley	in service ^a
LRG-430-S-15	28	Valley	in service
LRG-430-POD57	29B	Valley	in service
LRG-430-S-17	65	Valley	in service
LRG-430-POD58	31B	Valley	in service
LRG-430-POD59	32B	Valley	in service
LRG-430-S-20	33	Valley	in service
LRG-430-S-21	35	Valley	in service
LRG-430-S-22	36	West Mesa	not currently in service
LRG-430-S-23	37	West Mesa	not currently in service
LRG-430-S-25	54	Valley	not currently in service
LRG-430-S-27	39	Valley	in service
LRG-430-S-29	42	East Mesa	in service
LRG-430-S-30	43	East Mesa	in service
LRG-430-S-31	57	Valley	not currently in service
LRG-430-POD56	59B	Valley	in service
LRG-430-S-33	Driving Range	Valley	not currently in service
LRG-430-S-34	Paz Park	Valley	in service
LRG-430-S-35	60	Valley	not currently in service

^a operating as plume capture well for Griggs and Walnut tetrachloroethylene (PCE) plume

^b elevated uranium concentrations

^c casing collapsed

NMOSE - New Mexico Office of the State Engineer

Table 3. Existing and planned City of Las Cruces wells and associated NMOSE file numbers (continued)

NMOSE Well No.	City Well No.	well field	status
LRG-430-S-36	46	West Mesa	in service
LRG-430-S-37	61	Valley	in service
LRG-430-S-38	63	West Mesa	in service
LRG-430-S-39	64	West Mesa	not currently in service
LRG-430-S-40	48	West Mesa	not yet drilled
LRG-430-S-41	49	West Mesa	not yet drilled
LRG-430-S-42	67	Valley	in service
LRG-430-S-43	70	Valley	in service
LRG-430-S-44	71	Valley	in service
LRG-3283	No. not assigned	East Mesa	not yet drilled
LRG-3284	No. not assigned	East Mesa	not yet drilled
LRG-3285	No. not assigned	East Mesa	not yet drilled
LRG-3288	40	East Mesa	in service
LRG-3289	41	East Mesa	in service
LRG-3290	68	East Mesa	in service
LRG-3291	69	East Mesa	in service
LRG-3292	72	East Mesa	not currently in service
LRG-3293	No. not assigned	East Mesa	not yet drilled
LRG-3294	No. not assigned	East Mesa	not yet drilled
LRG-3295	No. not assigned	East Mesa	not yet drilled
LRG-3296	No. not assigned	East Mesa	not yet drilled
LRG-399	No. not assigned	Valley	not yet drilled
LRG-5818-S-7	66	Valley	not currently in service
LRG-5818-S-8	S-8	Valley	not yet drilled
LRG-5818-S-9	S-9	Valley	not yet drilled
LRG-5818-S-10	S-10	Valley	not yet drilled
LRG-5039	-	East Mesa	in service
LRG-5039-S	-	East Mesa	in service
LRG-5039-S-2	-	East Mesa	in service
LRG-47	-	East Mesa	in service
LRG-47-S	-	East Mesa	not currently in service
LRG-47-S-2	-	East Mesa	in service

^a operating as plume capture well for Griggs and Walnut tetrachloroethylene (PCE) plume

^b elevated uranium concentrations

^c casing collapsed

NMOSE - New Mexico Office of the State Engineer

Table 3. Existing and planned City of Las Cruces wells and associated NMOSE file numbers (concluded)

NMOSE Well No.	City Well No.	well field	status
LRG-47-S-3	-	East Mesa	in service
LRG-47-S-5	-	East Mesa	in service
LRG-47-S-6	-	East Mesa	in service
LRG-48	-	Valley	in service
LRG-48-S	-	Valley	not currently in service
LRG-48-S-2	-	Valley	in service
LRG-50	-	Valley	in service
LRG-50-S	-	Valley	not currently in service
LRG-50-S-2	-	Valley	not currently in service
LRG-50-S-3	-	Valley	not currently in service
LRG-50-S-4	-	Valley	in service
LRG-50-S-5	-	Valley	not currently in service
LRG-50-S-6	-	Valley	not currently in service
LRG-50-S-7	-	Valley	not currently in service
LRG-50-S-8		Valley	not yet drilled
LRG-50-S-9		Valley	not yet drilled
LRG-50-S-11	-	Valley	in service
LRG-50-S-12	-	Valley	in service
LRG-50-S-13	-	Valley	in service
LRG-1882	-	Valley	not currently in service
LRG-1882-S	-	Valley	in service
LRG-1882-POD4	-	Valley	in service
LRG-4278	-	East Mesa	not currently in service

^a operating as plume capture well for Griggs and Walnut tetrachloroethylene (PCE) plume

^b elevated uranium concentrations

^c casing collapsed

NMOSE - New Mexico Office of the State Engineer

2.1 LRG-430 et al. Wells in the Valley

The LRG-430 wells located in the Rio Grande Valley of the Mesilla Basin include 25 wells that are currently in service and pumped under Las Cruces' LRG-430 et al. groundwater right, which has a diversion right of 21,869 ac-ft/yr (Tables 1 through 3). The LRG-430 et al. right has a pre-Rio Grande project, 1905 priority date. As indicated in the LRG-430 Subfile Order (Appendix A), Las Cruces is not to consumptively use the treated effluent derived from the LRG-430 wells in periods of drought in which the EBID allotment to irrigators is less than 2 ac-ft/ac, but instead must return the effluent derived from the wells to the stream system.

The 25 wells currently in service in the Valley were completed between 1953 and 2012, to depths ranging from 460 to 1,070 ft. The wells have pumping capacities generally ranging from 300 to 2,900 gpm. Non-pumping water levels range from 30 to 240 ft, and pumping water levels range from 80 to 350 ft.

2.2 LRG-430 et al. Wells on the West Mesa

The LRG-430 wells located on the West Mesa of the Mesilla Basin include two wells that are currently in service and pumped under Las Cruces' LRG-430 et al. right, Wells 46 and 63 (Tables 1 through 3).

Wells 46 and 63 were completed in 1982 and 1996 to depths of 1,288 ft and 1,290 ft, respectively, with pumping capacities of 2,300 gpm and 3,100 gpm, respectively. Non-pumping water levels are 330 ft and 355 ft, and pumping water level is about 395 ft in these wells.

2.3 LRG-430 et al. Wells on the East Mesa

The LRG-430 wells located on the East Mesa in the Jornada del Muerto Basin include two wells that are currently in service and pumped under the City's LRG-430 et al. right, Wells 42 and 43 (Tables 1 through 3). These wells may eventually be transferred to the East Mesa permits LRG-3283 through LRG-3285 and LRG-3288 through LRG-3296.

Wells 42 and 43 were completed in 1998 to depths of 1,170 ft and 1,150 ft, respectively. The wells have pumping capacities of 1,670 and 1,500 gpm. Non-pumping water levels are 520 ft and 550 ft, and pumping water levels are 640 ft and 670 ft.

2.4 LRG-3283 through LRG-3285 and LRG-3288 through LRG-3296, Wells on East Mesa

The East Mesa permits LRG-3283 through LRG-3285 and LRG-3288 through LRG-3296 in the Jornada del Muerto Basin, for a total diversion of 10,200 ac-ft/yr, were approved by the NMOSE on February 4, 2002 (Table 1, Appendix B). These permits require 100 ac-ft/yr in offsets after 40

years, and 644 ac-ft/yr in offsets after 100 years of pumping; however, diversions under these permits will generate much more return flow than that. The remainder of the return flow is used to offset depletions associated with other permits including the West Mesa permit (Section 2.5 below), or water reclamation projects. The term “offsets” refers to the amount of water that is lost from the river as a result of pumping. Pumping a well can lead to some reduction of flow in the river either by intercepting water that would otherwise discharge to the river or by inducing some recharge from the river; the amount of the reduction is required to be offset. The offset requirements associated with pumping under the East Mesa permits are relatively small because the wells are far from the river, and there is a low-permeability boundary in the form of a bedrock high between the East Mesa Well Field in the Jornada del Muerto Basin, and the Rio Grande in the Mesilla Basin.

The East Mesa Well Field now includes four wells in service and pumped under the East Mesa permits (Table 3). These wells were completed between 1988 and 2012 to depths of 815 to 1,170 ft. The wells have pumping capacities of 520 to 1,440 gpm. Non-pumping water levels are 320 to 480 ft, and pumping water levels are 430 to 575 ft.

2.5 LRG-3275-POD1 through LRG-3275-POD7, Wells on the West Mesa

The West Mesa permit LRG-3275 et al. on the West Mesa of the Mesilla Basin, for a total diversion up to 8,000 ac-ft/yr, was approved by the NMOSE on March 9, 2010 (Table 1, Appendix C). Permit conditions indicate that the amount of water that may be diverted under LRG-3275 et al. will be re-evaluated and determined by NMOSE annually subject to any offset debt from previous calendar year(s) and anticipated availability of offsets in the current calendar year, pursuant to the Return Flow Plan (JSAI, 2009; Appendix H). Permit conditions also require a system gallons per capita day (GPCD) goal of 180 GPCD within 20 years, updates to the Water Conservation Plan every 10 years, progress reports on implementation of the 40-Year Plan every 10 years (at a minimum), and annual reports to NMOSE on water conservation efforts, overall GPCD and residential GPCD, and American Water Works Association (AWWA) system water audit. Wells have not yet been completed under LRG-3275 et al.

2.6 LRG-389, LRG-399 and LRG-5818 et al. Permits in the Valley

Permits LRG-389, for a diversion of 2,550 ac-ft/yr with offsets required, and LRG-399, for a diversion of 1,700 ac-ft/yr with offsets required, in the Valley of the Mesilla Basin, were approved by the NMOSE in 1989 (Table 1, Appendix I). The City has transferred a total of about 435.5 ac-ft/yr of groundwater rights into LRG-399.

LRG-389 has not yet been drilled, and extensions of time have been filed with the NMOSE. The permitted well location has been identified as having poor groundwater quality with respect to concentrations of naturally-occurring uranium. The permitted location may need to be further evaluated in terms of water quality variations with depth.

Alternative points of diversion for LRG-399, and for LRG-430-S-44 as supplemental well, were approved by the NMOSE on August 21, 2008. LRG-399 has not yet been drilled. LRG-430-S-44 (Well 71) was drilled in 2006 to a depth of 725 ft. The pumping capacity is 2,900 gpm, the non-pumping water level is about 40 ft, and the pumping water level is about 120 ft.

The LRG-5818 et al. permits are for a total diversion of 792 ac-ft/yr with offsets required (Tables 1 through 3, Appendix J). LRG-5818-S-7 (Well 66) has been drilled. Of the permitted 792 ac-ft/yr, 15 ac-ft/yr serves the Southwest Environmental Center for wetland restoration. Offsets are required for diversions exceeding 42.46 ac-ft/yr.

2.7 LRG-5039 et al., Mesa Development Acquisition, Wells on the East Mesa

City of Las Cruces has acquired the Mesa Development permit LRG-5039 et al., and associated wells, on the East Mesa in the Jornada del Muerto Basin (Tables 1 and 2, Appendix K). The acquisition was based on the amount that has been put to beneficial use, 106.866 ac-ft/yr. The City will not be able to acquire unperfected groundwater rights, if any, remaining under LRG-5039 et al.

LRG-5039 et al. includes three wells that are currently in service (Table 3). These wells were completed between 1964 and 1990 to depths of 550 to 600 ft. The wells have pumping capacities of 500 gpm each. The non-pumping water level is about 350 ft for these wells.

2.8 LRG-47 et al., LRG-48 et al., LRG-50 et al., LRG-1882 et al., and LRG-4278, Jornada Water Company Acquisition, Wells in the Valley and on the East Mesa

City of Las Cruces has acquired the Jornada Water Company permits LRG-47 et al., LRG-48 et al., LRG-50 et al., LRG-1882 et al., and LRG-4278, and associated wells in the Valley in the Mesilla Basin and on the East Mesa in the Jornada del Muerto Basin (Tables 1 and 2, Appendix Q). The acquisition totals 5,961 ac-ft/yr. The acquisition includes 14 wells that are currently in service based on meter records on file with the NMOSE (Table 3).

2.9 Water-Level Monitoring Program

LCU has maintained a water-level monitoring program, under which groundwater-level data have been collected at the City's supply wells based on a defined methodology and QA/QC process from mid-2011 to present (JSAI, 2016). The monitoring program includes monthly hand-

measurements collected at over 40 wells, plus transducer measurements recorded on an hourly basis in 12 wells plus the nested Jornada shallow, middle, and deep piezometers. Monitoring program wells are located in the Valley of the Mesilla Basin, on the West Mesa of the Mesilla Basin, and on the East Mesa of the Jornada del Muerto Basin. Water-level trends in these wells and the Jornada nested piezometer, plus USGS-monitored piezometers located close to the Rio Grande in Las Cruces, are analyzed in annual reports prepared for LCU (JSAI, 2016).

2.10 NMSU-Las Cruces Water Agreement

Las Cruces water system has been interconnected with the New Mexico State University (NMSU) water system since approximately 1967. The mutual water delivery responsibilities have been set forth in various agreements dated January 1, 1967 and March 23, 1983, which replaced the 1967 Agreement; and related agreements known as the Afton Agreement dated March 8, 2004, the Supplemental Agreement dated March 12, 2007, and the Letter of Understanding dated October 12, 2012. These agreements collectively were for short term emergency and peaking purposes capped at 3,500 ac-ft/yr. There was a Third Amendment to Ground Lease Agreement dated March 1, 2015 in which the City conditionally agreed to buy additional water from NMSU. The City has fully performed the water related provisions in the Letter of Understanding and the Third Amendment, and has terminated the Supplemental Agreement. Therefore, the 1983 Agreement remains in effect, and future water deliveries needed by the City from NMSU are reasonably expected to be minimal.

2.11 Legal Issues and Constraints

Many legal and administrative constraints affect the distribution of water in the Lower Rio Grande Basin, many of them unresolved, and at issue in pending litigation. A comprehensive summary of legal and administrative constraints may be found in the current draft of the 2016 Lower Rio Grande Regional Water Plan,¹ but that summary does not deal in any detail with the fundamental questions of state versus federal jurisdiction over surface water released from Elephant Butte Reservoir and groundwater in the underlying aquifer, the United States' claims for the Rio Grande Project, and associated issues that are important to Las Cruces. Those issues are now being addressed in *Texas v. New Mexico and Colorado* in the United States Supreme Court, and in *State of New Mexico v. Elephant Butte Irrigation Dist.*, the adjudication of Lower Rio Grande water rights

¹ See New Mexico State Engineer website: http://www.ose.state.nm.us/Planning/RWP/region_11.php.

in New Mexico State District Court. The following paragraphs describe the current status of the litigations in lay-reader language.

2.11.1 Rio Grande Project Operating Agreement and *Texas v. New Mexico and Colorado*

The management of Rio Grande Project surface water directly affects rights to divert groundwater in the Lower Rio Grande, and therefore has an important impact on the water available under Las Cruces' groundwater rights. Las Cruces presently relies entirely on groundwater for its municipal supply and will do so in the future. The constraints under which it uses groundwater will depend on three factors - implementation of the Operating Agreement, the Original Action brought by Texas in the United States Supreme Court, and the water rights adjudication in State District Court. Litigation currently pending in the U.S. Supreme Court, *Texas v. New Mexico and Colorado*, Original, No. 141, is likely to establish principles of water management and administration in the Lower Rio Grande for the future. Much of the following summary is derived from an *amicus curiae* brief filed in 2013 by the City's legal counsel,² from the City's *amicus curiae* brief in support of the State of New Mexico's Motion to Dismiss the case,³ and from a 2009 report to Las Cruces by John Shomaker & Associates.⁴

The Operating Agreement

In 2008, an Operating Agreement was negotiated among EBID, EP No. 1, and the U.S. Bureau of Reclamation (BOR) to govern the releases of surface water from Elephant Butte Reservoir. In effect, rather than sharing shortages as would have occurred under the earlier management of the system, in which each acre in both EBID and EP No. 1 would receive the same annual allocation, EP No. 1 instead receives the annual amount of water that would be consistent with the "D2 curve" developed by the BOR as if the Project Supply conditions for the period 1951-1978 remained unchanged. The D2 curve relates the historical amount of water available to divert from the river at canal headings ("Project Supply") with the amount released from reservoir storage ("Project Release"), recognizing that part of the water applied to lands becomes return flow, available to be diverted again. The relationship between the two annual quantities, Project Release and Project Supply, defined for the period 1951-1978, and expressed as the D2 curve, determined the total amount of water that could be diverted from the Rio Grande by EBID, EP No. 1, and the Republic of Mexico.

² City of Las Cruces' *Amicus Curiae* Brief Opposing Texas' Motion for Leave to File a Bill of Complaint and Supporting Defendants, *State of Texas v. State of New Mexico and State of Colorado*, March 11, 2013.

³ City of Las Cruces' *Amicus Curiae* Brief in Support of New Mexico's Motion to Dismiss Texas' Complaint and the United States' Complaint in Intervention

⁴ Shomaker, J.W., 2009, Long-term effects on Lower Rio Grande water supply of Rio Grande Project Operating Agreement ("D3") and Pecan-Growers Settlement with State Engineer: John Shomaker & Associates, Inc., consultant's report to City of Las Cruces.

Mexico will receive the amount determined from the “D1 curve,” which is based on the amount of water available to be released, regardless of the amount of water that remains for EBID. Shortages of Project surface water would be borne by EBID.

However, the conditions in the basin no longer reflect the 1951-1978 relationship defined by the D2 curve, and “[a]fter the Operating Agreement became public, hydrologic analysis by New Mexico revealed that the effect of the Operating Agreement was to alter the historical releases of the Rio Grande Project surface water from Elephant Butte Reservoir which had been made 57% to EBID and 43% to EP No. 1 [based on the areas of irrigated lands in the respective projects] to a new ratio, possibly as low as 38% to EBID and 62% to EP No. 1. The consequence is to significantly increase groundwater pumping in New Mexico, thus decreasing groundwater in storage where the City’s groundwater rights are located.”⁵

One implication of the Operating Agreement is that supplemental irrigation pumping to supply EBID lands would increase, so that groundwater levels in the Lower Rio Grande Basin in general, and the Mesilla Valley in particular, would decline, rather than being roughly in equilibrium as had been the case historically. Groundwater mining may eventually lead to an unsustainable condition. On August 8, 2011, New Mexico filed suit in federal district court in New Mexico⁶ to invalidate the Operating Agreement. The City of Las Cruces intervened in the case on February 17, 2012, on Count V of New Mexico’s Complaint, *i.e.*, to compel the United States to complete an Environmental Impact Statement (EIS) identifying the effects of increased groundwater pumping on water in storage in the aquifer, where the City’s rights are located, over the projected 50-year life of the Operating Agreement. The City has actively participated in the NEPA process related to the BOR’s proposed EIS.

Texas v. New Mexico & Colorado

Evidently concerned that the favorable treatment of EP No. 1 under the Operating Agreement might be in jeopardy, Texas filed a Motion for Leave to File a Bill of Complaint in the United States Supreme Court on January 8, 2013, alleging that New Mexico had violated the terms of the Rio Grande Compact by allowing diversions of surface water and groundwater in excess of the 1938 conditions, more specifically that “[t]he Rio Grande Compact is predicated on the

⁵ City of Las Cruces’ *Amicus Curiae* Brief Opposing Texas’ Motion for Leave to File a Bill of Complaint and Supporting Defendants, *State of Texas v. State of New Mexico and State of Colorado*, March 11, 2013, p. 7.

⁶ *State of New Mexico v. U.S. Bureau of Reclamation et al.*, No. 1:2011-cv-00691-JB-ACT.

understanding that delivery of water at the New Mexico–Texas state line would not be subject to additional depletions beyond those that were occurring at the time the Rio Grande Compact was executed. New Mexico, through the actions of its officers, agents and political subdivisions, has increasingly allowed the diversion of surface water, and has allowed and authorized the extraction of water from beneath the ground, downstream of Elephant Butte Dam, by individuals or entities within New Mexico for use within New Mexico. The excess diversion of Rio Grande surface water and the hydrologically connected underground water downstream of Elephant Butte Reservoir adversely affects the delivery of water that is intended for use within the Rio Grande Project in Texas.”⁷ New Mexico contends that the Compact does not govern the delivery of water at the state line, and that it has met the terms of the Compact.

On March 31, 2014, the United States was granted leave to intervene in *Texas v. New Mexico & Colorado*. The United States contends that groundwater in storage is “Project supply” for which contracts are required with BOR by users of groundwater in New Mexico. Texas and the United States argue that it was “understood” that the Rio Grande Compact requires the delivery of a specific amount of water at the New Mexico-Texas state line. They argue that the Rio Grande Compact resulted in a tacit apportionment of the groundwater of the Lower Rio Grande, resulting in New Mexico being locked into 1938 conditions not applicable to Texas and the United States, then posit that all surface water and hydrologically-connected groundwater below Elephant Butte Reservoir in New Mexico are Rio Grande Project water, which the United States contends cannot be diverted without obtaining a water supply contract from it. *See* United States’ Complaint in Intervention at 4, ¶¶ 12 and 13. This position results in New Mexico being divested of state jurisdiction over all surface water and groundwater in the Lower Rio Grande, assuming that all groundwater is hydrologically connected, threatening the viability of Las Cruces’ water supply and requiring the City to enter into a water supply contract with the United States to divert groundwater in the Lower Rio Grande for municipal use, despite the fact that the City’s groundwater use was initiated more than 100 years ago, prior to the Rio Grande Project. New Mexico filed a Motion to Dismiss which addressed claims by both Texas and the United States. Las Cruces filed an *amicus curiae* brief in support of New Mexico’s motion. Oral argument was held before the Court’s Special Master, Gregory Grimsal, in New Orleans on August 19, 2015. A

⁷ Texas’ Motion for Leave to File Complaint, Complaint, and Brief in Support of Leave to File Complaint, *State of Texas v. State of New Mexico and State of Colorado*, January 2013, p. 9.

draft Report was issued for comments on July 1, 2016, and comments were received from the parties and amici on August 1, 2016. A conference call hearing was held on August 11, 2016.

In his draft Report, the Special Master denied New Mexico's motion to dismiss Texas' claims, but granted the motion to dismiss the United States' claims with the following proviso - he recommended that "the Court extend its original, but not exclusive, jurisdiction...to allow for the resolution by the Court of the United States' project claims to occur simultaneously with the resolution of Texas's compact claims against New Mexico. (First Report of Special Master, 2011, p. 205)." If the Court concurs, and the United States prevails on this point, Las Cruces' groundwater may be deemed to be Rio Grande Project water and the City may be required to enter into a contract with the BOR to continue to divert it. In that case, it is possible that the water would be subject to re-assignment to, for example, Endangered Species Act purposes, as has occurred in the Middle Rio Grande.

Las Cruces has established, in the context of the adjudication of Lower Rio Grande water rights (see below), a priority date of 1905 for its pre-basin (and pre-Rio Grande Project) water rights under File No. LRG-430. The Special Master's report (see First Report of the Special Master, June 28, 2016, p. 184) seems to imply that such pre-basin and pre-Rio Grande Project rights are recognized, but that the water to supply them must come from the New Mexico allocation under the Rio Grande Project. The question remains, then, whether Las Cruces' rights would be fully supplied in priority, in their status as senior to the January, 1906 filing of the notice of appropriation for the Rio Grande Project by the U.S. Reclamation Service (see, e.g., First Report of the Special Master, June 28, 2016, p. 83), as they would be under New Mexico law, or would be subject to the shortage-sharing implicit in the distribution of water within the Project (see, e.g., Frank Clayton letter, reproduced in part in First Report of the Special Master, June 28, 2016, p. 179). If the Rio Grande Project is the "sole method" by which the Rio Grande valley in New Mexico receives its equitable apportionment from the stream (First Report of the Special Master, June 28, 2016, p. 175), it seems probable that Las Cruces would share shortages.

The Special Master's report does not deal explicitly with the relation between groundwater and surface water, and seems to treat surface water and its allocation as the only hydrologic issue. This could be the situation only if the groundwater system has always been and will continue to be full. In that context, the streamflow depletion associated with declared pre-Lower Rio Grande Basin groundwater rights, such as LRG-430, would represent an appropriation to be supplied by Rio Grande Project surface water in amounts equivalent to the amounts pumped from wells, less the return flow to the river. Arguably the withdrawal from groundwater in storage in the aquifer represented by a permanent lowering of the water table should not be considered an appropriation

of Project water, although any natural replenishment of the water withdrawn from storage, if and as it occurs, would be by Project water.

The Utton Transboundary Resources Center at the University of New Mexico has described the consequences of a New Mexico loss in part as follows (references omitted).⁸

[It]...would be very expensive for the communities in south-central New Mexico in terms of losses in agricultural and supporting businesses and to the state in general. The area is already strained by reduced surface water availability from the drought and under the Operating Agreement. If the U.S. Supreme Court ordered curtailment of groundwater pumping, the pecan orchards and other crops may be severely damaged or lost. The Supreme Court could also order restitution in the form of water or money or both. Texas is asking the Court for compensation for New Mexico pumping since the date of the Rio Grande Compact, that is, 1938. If, as in the Pecos litigation, New Mexico must retire farmland water rights to accommodate a judgment, the cost has been estimated to be upwards of \$1 billion dollars. If solutions such as augmentation well fields or pipelines are required, millions more will follow.

However, the cost of doing nothing could be just as devastating. In June of 2012, the Interstate Stream Commission reported that estimated value of water reallocated in the Project between EBID and EP No. 1 was between several million to 2.5 billion dollars.

Between the reallocation and the [then continuing] drought, farmers, municipalities and others have turned increasingly to groundwater. Not only does extensive groundwater use threaten the aquifer sustainability but it also threatens to change the aquifers from sustainably managed resources to mined resources. If groundwater pumping must continue over the long run, river losses to the aquifers are likely to remain high, and deliveries to EP No. 1 will continue to be a problem.

Another consequence of a New Mexico loss in the Supreme Court may be “federalization” of the management of the river. The United States has alleged that “New Mexico has allowed the diversion of surface water and the pumping of groundwater that is hydrologically connected to the Rio Grande downstream of Elephant Butte Reservoir by water users who either do not have contracts with the Secretary [of the Interior] or are using water in excess of contractual amounts...,” and has asked the Supreme Court to “declare that New Mexico...may not permit parties not in privity with

⁸ Utton Transboundary Resources Center, University of New Mexico, 2013, uttoncenter.unm.edu/pdfs/2013-05-16_BushnellTx-NM-Final.pdf

the Bureau of Reclamation...to intercept or interfere with delivery of water from the Rio Grande Project (see First Report of the Special Master, June 28, 2016, p. 188).”

If New Mexico ultimately prevails in *Texas v. New Mexico and Colorado*, and operation of the Rio Grande Project returns to something like the pre-Operating Agreement procedures, it seems likely that some of the economic stress in the Lower Rio Grande would still occur if water shortages continue. The probability of priority administration seems likely to increase, and either in that context or in a process of promulgating new administrative guidelines, the State Engineer may seek to curtail or limit groundwater pumping. Las Cruces’ 1905, pre-Rio Grande Project, priority date would presumably protect the City’s full supply from the LRG-430 rights in the case of a priority call, but permits for supplemental and replacement wells may become more difficult to obtain under new administrative guidelines.

Figure 7 presents a summary of the Lower Rio Grande Basin water balance based on the groundwater flow model prepared for the NMOSE by S.S. Papadopoulos & Associates, Inc. (SSPA, 2007), and illustrates how water shortages and groundwater pumping have resulted in losses in groundwater storage. The SSPA (2007) model represents one of the most sophisticated models available for the Lower Rio Grande Basin. A version of it is currently being updated, and other models are being developed in preparation for the litigation described above. The high pumping in 2003 and 2004, and precipitous decline in groundwater storage, is likely representative of more recent years.

2.11.2 Rio Grande Adjudication

New Mexico v. EBID, et al., 96-CV-888 (1996) is a state court adjudication being undertaken to identify and to formalize the scope and the description of valid water rights in the area between the Elephant Butte Dam and the state line with Texas. The adjudication is one of the largest in New Mexico and will determine water right claims in about 14,000 subfiles - each of which deals with one or more water rights - and for about 18,000 claimants. The adjudication court and the parties are also working out the stream system issues: so-called because their resolution will affect many if not all of the claimants in the case. The court has or will determine the following stream system issues: 1) the farm delivery requirement (FDR) and the consumptive irrigation requirement (hereinafter CIR) for all crops; 2) the groundwater rights of the Elephant Butte Irrigation District (hereinafter EBID); 3) the status and description of domestic wells; 4) the rights and the nature of the rights of the United States

in the Rio Grande Project; 5) the claims of those whose water rights predate those of the Project; and 6) the claims of the Nathan Boyd Estate.

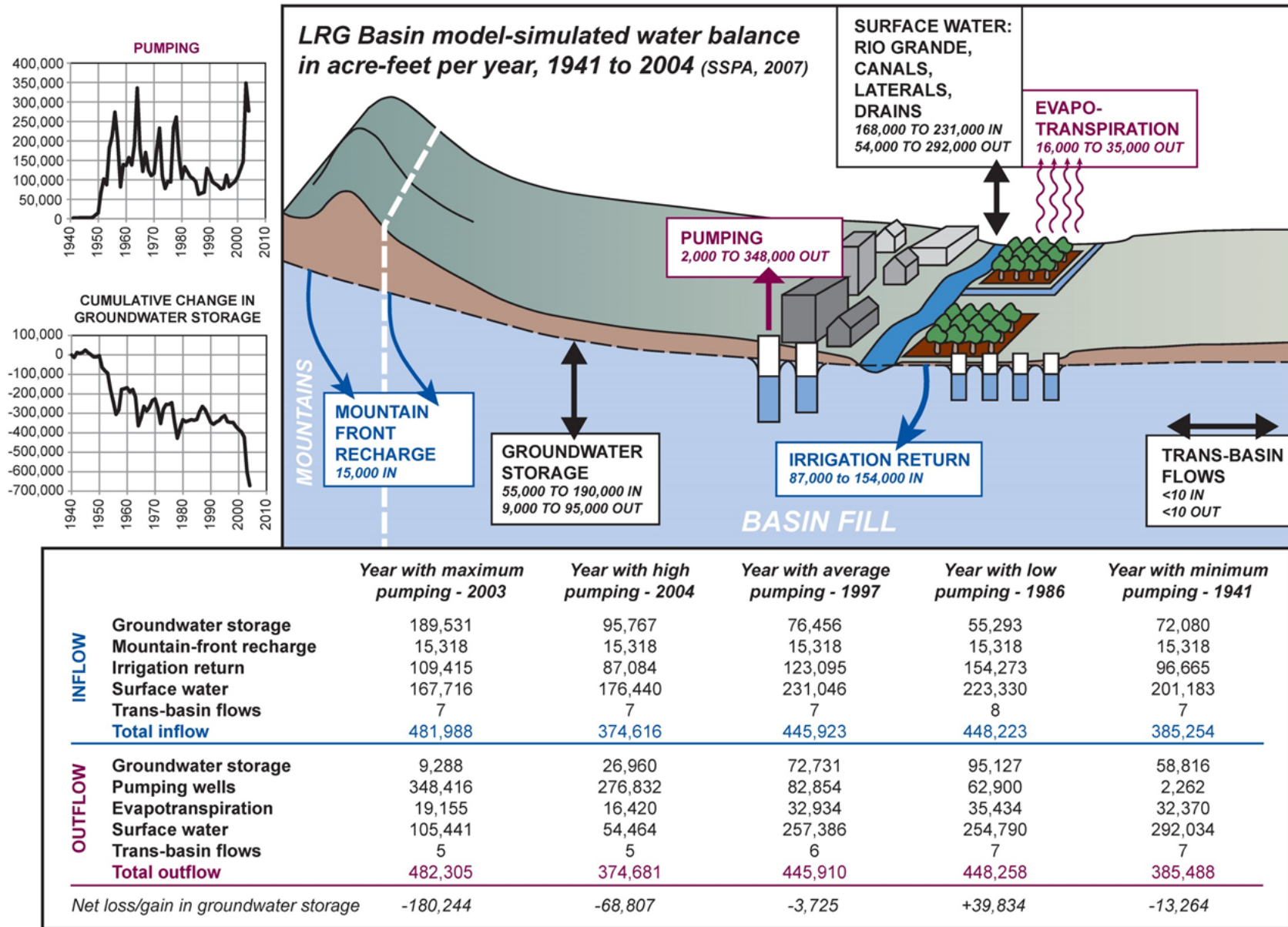


Figure 7. Illustration of Lower Rio Grande Basin water balance based on the groundwater flow model prepared by SSPA (2007).

As of the writing of this report, the adjudication court has established the farm delivery requirements and consumptive irrigation requirements for irrigation, and, as may be of interest to Las Cruces, has ordered that “[f]or future transfers to non-irrigation purposes of use, a CIR of 2.6 afay (ac-ft/yr per acre) shall apply to all irrigated acreage in the Lower Rio Grande,” and that “[o]nly the full amount of combined surface water rights and groundwater rights can be transferred.”⁹ The court has also established the groundwater rights of the EBID.¹⁰ The court granted a motion to dismiss the claims of the Boyd Estate, and the New Mexico Court of Appeals has affirmed the adjudication court’s dismissal. A newly raised issue to be resolved is “the question of whether surface water rights developed before the Rio Grande Project and now served by the Project were extinguished by any means.”¹¹ This may become important for Las Cruces in that depletion of the Rio Grande due to pumping under the pre-Project groundwater rights represents an implied pre-Project surface-water right. The City may make pre-Project claims for uses by the Acequia Madre de Las Cruces in connection with this stream system issue.

As of the State’s annual report for Fiscal Year 2016,¹² the majority of the City of Las Cruces rights, consisting of the LRG-430 wells with the right to divert 21,839 ac-ft/yr, and excepting the Jornada and West Mesa wells and some other rights, had been adjudicated. Almost all of the rights in the Nutt-Hockett and Rincon sections of the Lower Rio Grande had been adjudicated, and offers of judgment had been served for about one-half of the subfiles in the combined Northern Mesilla and Southern Mesilla sections. Of the total number of subfiles in the Mesilla sections, about 35 percent had been adjudicated.

The United States’ interest, designated as Stream System Issue No. 104, has been partially completed. On August 16, 2012, the Court ruled that the United States’ interest consisted of surface water stored in Elephant Butte Reservoir and released for use by the Rio Grande Project - and not a commensurate amount of groundwater. An outstanding issue concerns the United States’ priority date. The United States claims a date of no later than March 1, 1903. The City and the State assert that the United States’ priority date is January 23, 1906, for 730,000 ac-ft/yr, and April 14, 1908, for 60,000 additional ac-ft/yr in accordance with filings by the U.S. Reclamation service with the Territorial Engineer. The adjudication court has not yet decided the priority date issue.

⁹ See Final Judgment, SS-97-101, *New Mexico v. EBID, et al.*, 96-CV-888 (1996), August 22, 2011.

¹⁰ See Stipulated Subfile Order, Subfile No. LRS-28-003-0018, *New Mexico v. EBID, et al.*, 96-CV-888 (1996), October 4, 2010.

¹¹ See Order designating Stream System Issue No. 107 regarding surface water rights developed before the Rio Grande Project, SS-97-107, *New Mexico v. EBID, et al.*, 96-CV-888 (1996), July 6, 2016.

¹² Lower Rio Grande Adjudication Bureau, State of New Mexico’s Rule 71.3 Report, FY 2016.

From the layman's point of view, the outcome of the adjudication would seem largely irrelevant if Texas prevails in *Texas v. New Mexico and Colorado*, and the distribution of all waters downstream from Elephant Butte dam by the Bureau of Reclamation is based on acreages and shortage-sharing rather than priority administration. It would remain only to determine the fraction of New Mexico's allocation that is represented by Las Cruces' pre-Project water rights, and for Las Cruces to enter into a contract with the Bureau of Reclamation.

2.11.3 Return Flow Discussion

Las Cruces' water rights and permits carry with them a variety of conditions, including requirements for discharge of certain amounts of water to the natural system after use. Las Cruces' Return-Flow Plan (JSAI, 2009), which compiles the various requirements for return flows, and presents the City's plan for meeting them, was accepted by the NMOSE in 2009. Figure 8 presents a schematic illustration of the City's return-flow requirements and accounting.

2.11.4 Water Banking Discussion

Discussions of water banking and how it might be implemented in the Lower Rio Grande Basin to repay groundwater over-diversion and out-of-priority diversion are ongoing among the NMISC, NMOSE, and stakeholders in the region (Colby, 2015). Water banking in the Lower Rio Grande Basin will depend on the outcome of *Texas v. New Mexico and Colorado* (see Section 2.11.1, above).

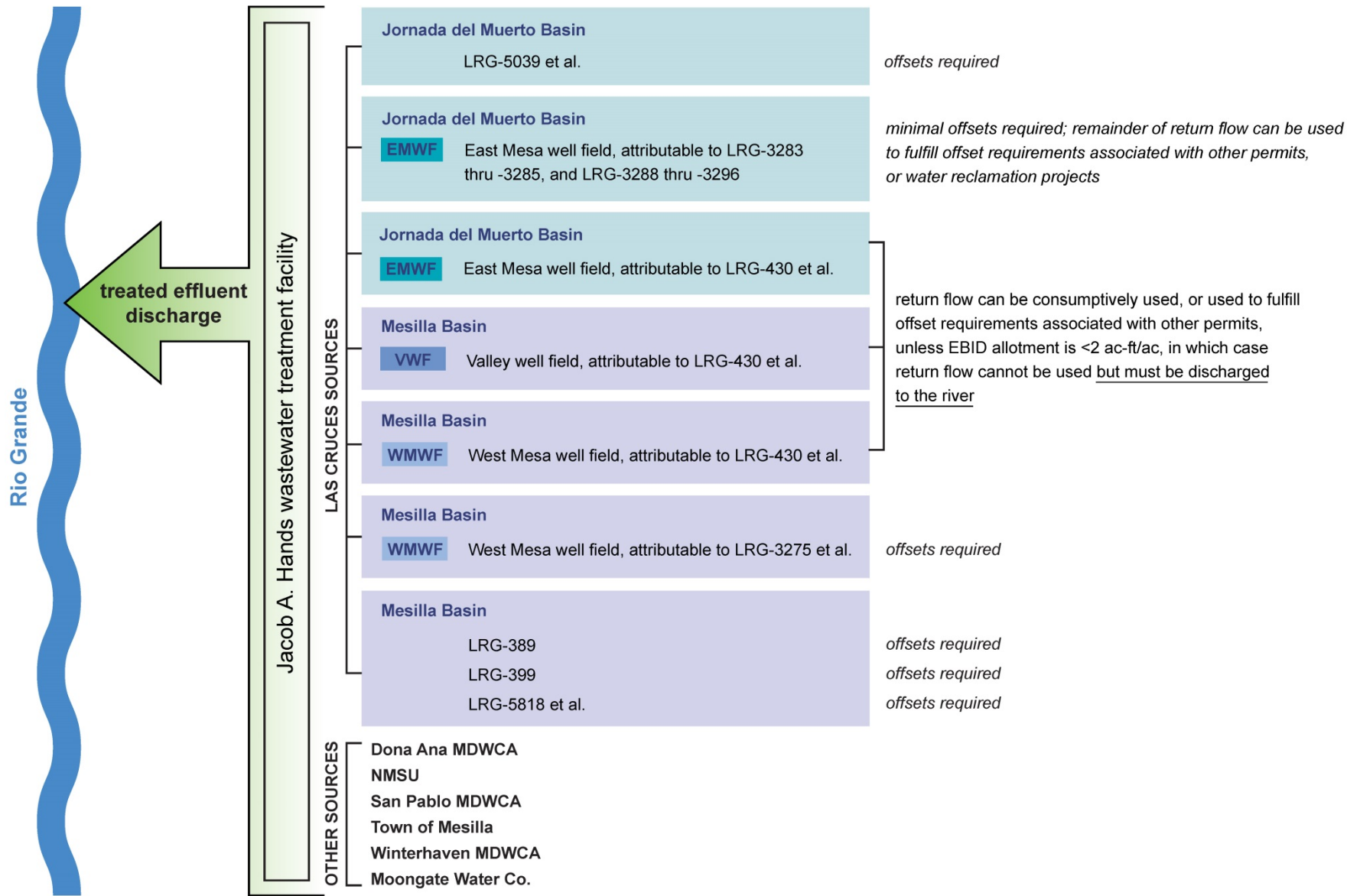


Figure 8. Schematic illustration of City of Las Cruces return flow accounting.

3.0 WATER DEMAND PROJECTIONS

Water demand projections are based on projected population growth and goals for total gallons per capita per day (GPCD) water use.

3.1 Population Projections

Figure 9 and Table 4 present projected population growth for 2015 to 2055. Figure 9 also presents historical population growth from 1960 to 2014. Projected population growth is presented as lines spanning low to high growth in Figure 9.

The medium-growth projection represents 1.9-percent annual growth between 2015 and 2055. The medium-growth projection is from the City’s Land Use Assumptions Study (Water and Wastewater Impact Fee Study; Duncan Associates, 2013). It is based on the range of estimated population growth forecasts used by the City and County in the Vision 2040 regional planning project (Doña Ana County, 2012), and assumes that the City’s share of future growth will be a consistent 46.9-percent share of the County’s population.

Table 4. City of Las Cruces population projections

year	high growth ^a	medium growth ^b	low growth ^c
2015	109,094 ^d	109,094 ^d	109,094 ^d
2020	122,829	119,859	117,544
2025	138,293	131,687	126,462
2030	155,704	144,682	135,481
2035	175,307	158,959	144,500
2040	197,378	174,645	153,519
2045	222,228	191,878	162,753
2050	250,207	210,813	172,542
2055	281,708	231,616	182,920

^a 2.4-percent annual growth (historical average, 1960-2014)

^b Based on 1.9-percent annual growth indicated in City of Las Cruces Water and Wastewater Impact Fee Study, Land Use Assumptions (Duncan Associates, 2013)

^c 1.5-percent annual growth (2015 to 2023) decreasing to 1.2-percent annual growth (2035 to 2055), City of Las Cruces Comprehensive Plan 2040 (City of Las Cruces, 2013)

^d 2015 estimate presented in City of Las Cruces fiscal year 2015-2016 budget adopted by the City Council in May 2015, plus 2,016 Jornada Water Company customers outside City limits multiplied by average household size of 2.43 (U.S. Census 2010)

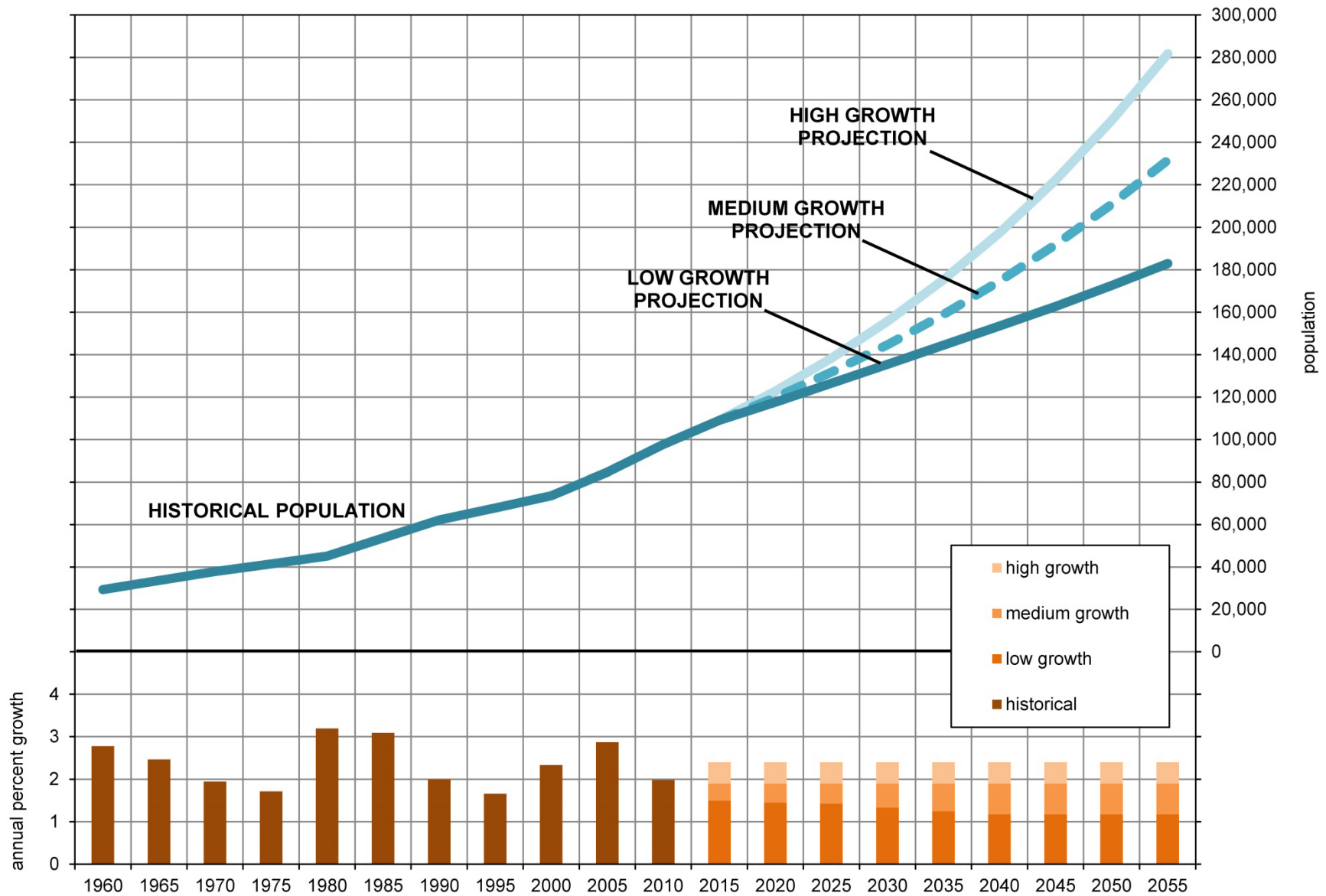


Figure 9. Graph showing City of Las Cruces historical and projected population growth, and percent annual growth, 1960 to 2055.

The high-growth projection is based on U.S. Census historical population data for City of Las Cruces from 1960 to present, with an average annual growth rate of 2.4 percent. Although population growth has been significantly less than the historical average over the last few years, the historical average growth rate should be considered for long-range planning purposes. Planning according to the historical average rate will allow LCU to perfect the water rights in the place-of-use area; LCU recognizes that there is some overlap with areas served by other utilities and place-of-use of water rights from other utilities, such as Moongate Water Company.

The low-growth projection represents 1.5-percent annual growth in 2015 decreasing to 1.2-percent annual growth in 2035. The low-growth projection is from the City's Comprehensive Plan 2040 (City of Las Cruces, 2013), which was adopted by City Council in November 2013. It agrees closely with population projections for Doña Ana County prepared by the University of New Mexico Geospatial and Population Studies (GPS) Group, which represents 1.5-percent annual growth in 2015 decreasing to 1.0-percent annual growth in 2035 (GPS Group; <https://bber.unm.edu/demo/PopProjTable2.htm>).

The New Mexico Universities Working Group on Water Supply Vulnerabilities (2015) indicates that "recent investments and developments in the Santa Teresa, NM area will likely lead to additional businesses (re)locating to the area, and thus to additional population growth." In early 2014, the Union Pacific Santa Teresa Intermodal Terminal was opened. Located about 40 miles from Las Cruces near the Santa Teresa Port of Entry, the terminal can handle 250,000 shipping containers annually. Santa Teresa also includes two industrial parks.

A Las Cruces Sun-News article from October 19, 2015, indicates that plans for construction of the Center for Innovation, Testing and Evaluation (CITE) are moving forward on a 500-acre site about 25 miles west of Las Cruces (Gibbs, 2015a). CITE will be used for scientific research and testing of innovative technologies, building materials, and renewable energy, and will be open to private companies to test products. The facility could be operational by 2018, and the construction investment could run as high as \$600 million. CITE will offer the opportunity for interconnection and research with NMSU, Spaceport, and other regional assets.

Las Cruces also includes the 1,800-acre West Mesa Industrial Park, located about 8 miles west of the City and directly south of Las Cruces Airport. The Industrial Park currently has 14 tenants, and it is the City's intent to develop light industry, general manufacturing, and aviation related and technology based industries, within the Industrial Park over the 40-year planning period. The City is dedicated to bringing in industries and manufacturing businesses that will expand and diversify the local economic base and provide new jobs for the community. A Las Cruces Sun-News article from September 10, 2015, indicates that manufacturing businesses in the Industrial Park are showing

growth. F&A Dairy Products has two processing plants, and is currently hiring as it ramps up from 80-percent production capacity to 100-percent capacity. ARCA Space Corporation and Engineered Wire Products are also hiring (Gibbs, 2015b).

The NMOSE GPCD Calculator calculates utility-served population based on actual single-family and multi-family residential connections, and U.S. Census data on household size and population in group quarters. In the case of City of Las Cruces, utility-served population has ranged from about 98 to 105 percent of U.S. Census population, and 100 percent of U.S. Census population on average. Therefore, it was not necessary to adjust City population numbers to reflect utility-served population even though some areas on the East Mesa are served by Moongate Water Company. The current utility-served population has been adjusted to account for 2,016 new utility customers (formerly Jornada Water Company customers) outside the City limits, multiplied by an average household size of 2.43 (U.S. Census 2010).

3.2 Goals for Total Gallons Per Capita Per Day Water Use

Using historical data on total diversions, and utility-served population calculated using the NMOSE GPCD spreadsheet (version 2-05) and U.S. Census 2010 data, total GPCD water use was calculated for years 2009 to 2015 and presented in Table 5. Figure 10 presents current and projected total GPCD water use, and Figure 11 presents average total GPCD use by month (also see Appendix L). Total GPCD represents total water supply (total water diverted plus imports minus exports) divided by the population served by the utility.

Current total GPCD of 181 GPCD does not factor in GPCD for former Jornada Water Company customers; water use data for the former Jornada Water Company are currently inadequate to calculate GPCD for these customers. Current total GPCD of 181 GPCD does not factor in the City's effluent discharge to the Rio Grande. If effluent discharge to the Rio Grande (attributable to City water sources; 39 percent of total water supply on average, 2009-2014) were factored into Las Cruces GPCD, the City's current total GPCD would be only 110 GPCD. Current total GPCD of 181 GPCD is in-line with the average for Doña Ana County of 182 GPCD based on GPCD calculations for 63 public water systems (NMISC, 2016). It should be noted that this GPCD dataset for Doña Ana County includes high variability, and may include data of varying quality.

Las Cruces has the goal of reducing total GPCD water use to 165 GPCD by 2030, and 140 GPCD by 2055 (Fig. 8). This number does not factor in former Jornada Water Company customers; water use data for the former Jornada Water Company are currently inadequate to determine a realistic GPCD goal for these customers. This number does not factor in effluent discharge to the Rio Grande. Table 5 presents projected total GPCD use, and corresponding reductions in total GPCD use with respect to the current value of 181 GPCD (2009 to 2015 average).

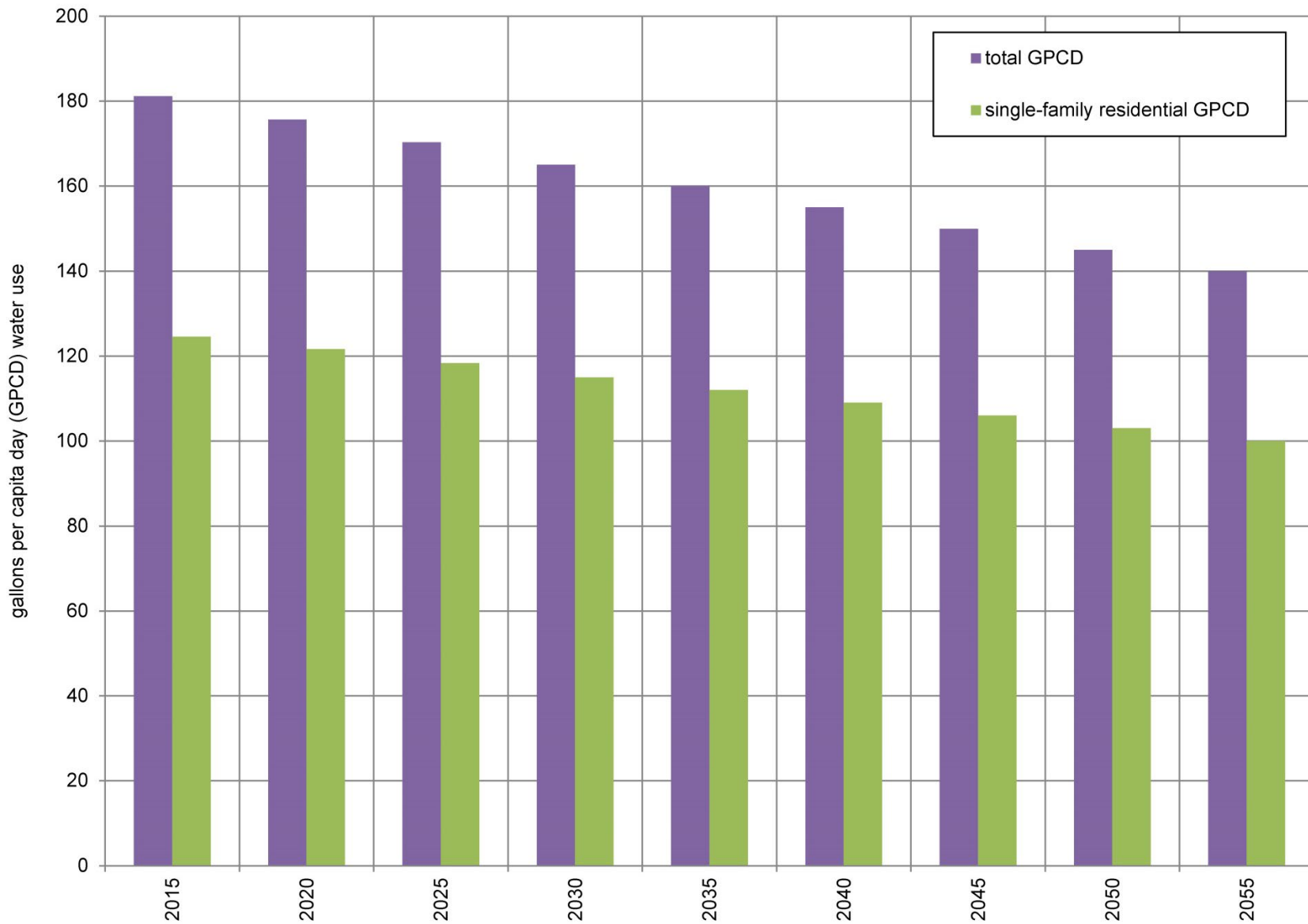


Figure 10. Chart showing City of Las Cruces current and projected total and single-family residential gallons per capita per day (GPCD) water use, 2015 to 2055.

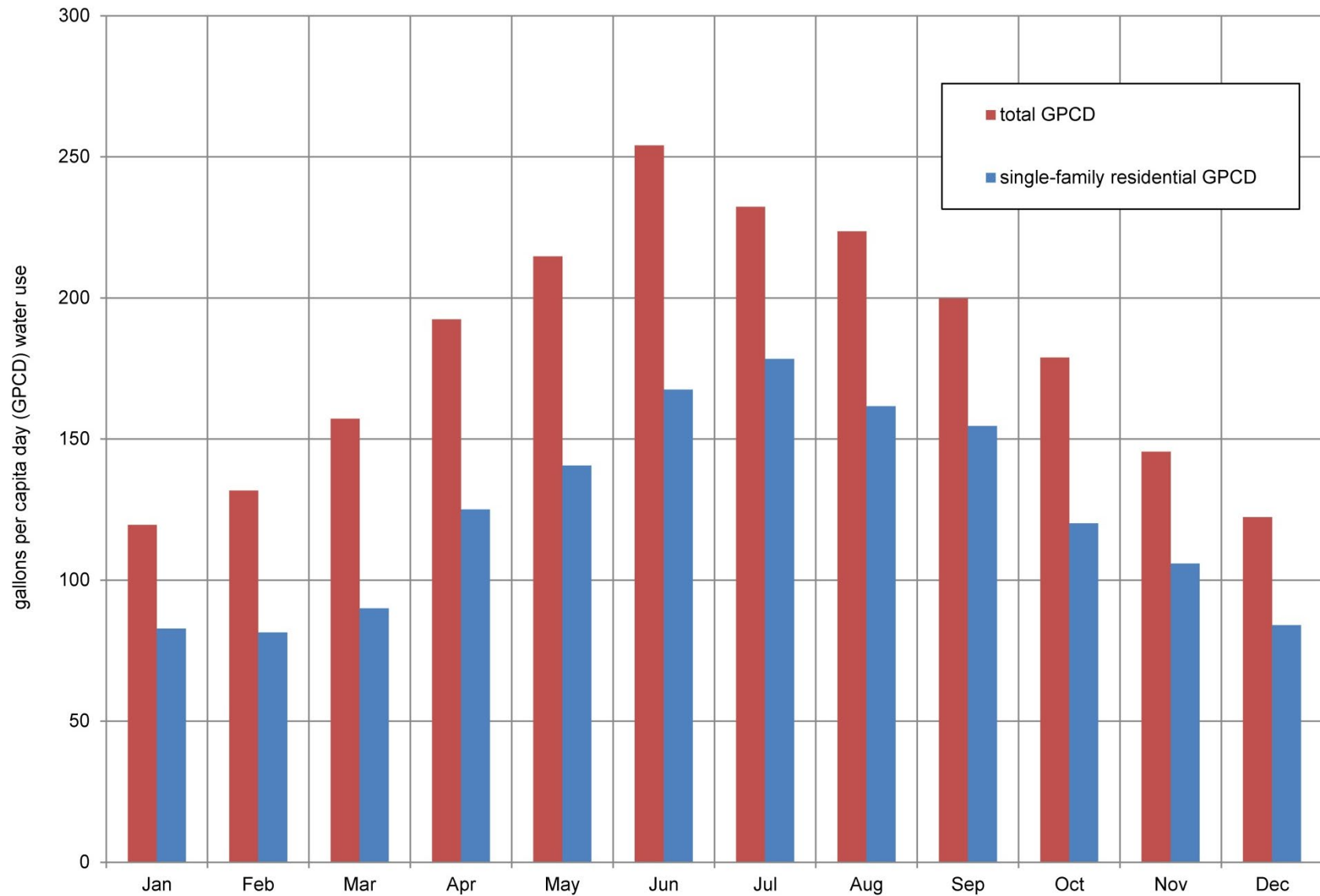


Figure 11. Chart showing City of Las Cruces average (2009 to 2015) total and single-family residential gallons per capita per day (GPCD) water use by month.

Table 5. City of Las Cruces total GPCD projections

year	total GPCD	reduction in total GPCD with respect to 2009-2015 average value ^a	tactics for reducing total GPCD
2009	188	-	-
2010	181	-	-
2011	192	-	-
2012	184	-	-
2013	176	-	-
2014	176	-	-
2015	171	-	-
2009-2015 avg	181	0	-
2015	181	0	reduce non-revenue water to 9 percent; reduce single-family residential GPCD use; implement Water Conservation Program
2020	176	5	
2025	170	11	
2030	165	16	
2035	160	21	
2040	155	26	
2045	150	31	
2050	145	36	
2055	140	41	

^a based on high-growth population projections

GPCD - gallons per capita per day

Details on how the City will meet the goal of reducing total GPCD water use to 140 GPCD by 2055 are presented in Section 4: Water Conservation. Total GPCD water use goals will be met by implementation of the Water Conservation Program, which aims at reducing single-family residential GPCD and also works with City government and industrial, commercial, and institutional customers, and by reducing total non-revenue water from the 2010-2015 average of 15 percent of diversions, to 9 percent by 2055.

Las Cruces’ total GPCD goal of 140 GPCD will allow the City to maintain the ability to serve future commercial and industrial accounts that will develop in the West Mesa Industrial Park over the next 40 years, thereby regulating industrial development to insure environmental sustainability and protect water quality. Las Cruces is part of the rapidly-developing commercial and industrial complex along the U.S./Mexico border. As the City grows over the next 40 years, Las Cruces’ water system will serve existing and new water users in the commercial and industrial sectors, while private water companies and mutual domestic water consumers associations in the area will serve primarily residential users. Thus, the proportion of City water used for commercial and industrial purposes may grow, and the proportion of City water used for residential purposes may decrease.

Las Cruces’ total GPCD goal of 140 GPCD is progressive in comparison to other water systems in the southern part of New Mexico (Table 6). City of Alamogordo has a goal of 165 GPCD (Livingston Associates, 2006; JSAI, 2005). The preliminary 40-year plan for City of Hobbs does not indicate a specific goal, and uses 264 GPCD when calculating projected demand (DBSA, 2009a). The 40-year plan for City of Deming does not indicate a specific goal, and uses 206 GPCD when calculating projected demand (DBSA, 2009b). City of Lovington has a goal of 242 GPCD (JSAI, 2014). Truth or Consequences/Williamsburg has a goal of 176 GPCD (WHPacific, 2012). City of Jal indicates a goal of 165 GPCD; however, this is in terms of residential GPCD (JSAI, 2005). The City of Jal 40-year plan uses 290 GPCD when calculating projected demand.

Table 6. Comparison of City of Las Cruces total GPCD goal with other water systems in southern New Mexico

community	projected year	projected population ^b	projected total demand, ac-ft/yr	total GPCD goal
Las Cruces	2055	269,058	42,222	140
Alamogordo	2045	58,663	10,842	165
Alamogordo without wastewater reuse	2045	58,663	10,842 + 3,363 ^a	216
Hobbs	2050	54,660	16,190	264
Deming	2050	39,526	9,119	206
Lovington	2053	22,670	6,157	242
Truth or Consequences and Williamsburg	2050	14,134	2,795	176
Jal	2045	6,127	1,990	290

^a 3,000,000 gallons per day wastewater reuse

^b high growth projection

ac-ft/yr - acre-feet per year
GPCD - gallons per capita per day

It is important to note a key difference between these water systems and Las Cruces: Las Cruces has return flow, and these other systems do not (with the exception of Truth or Consequences/Williamsburg). In the case of Alamogordo, wastewater reuse is considered into its total GPCD goal of 165 GPCD; its total GPCD goal without wastewater reuse would be about 216 GPCD.

3.3 Goals for Single-Family Residential Gallons Per Capita Per Day Water Use

Single-family residential GPCD water use, calculated for years 2009 to 2015, is presented in Table 7. Historical single-family residential GPCD water use was calculated using the NMOSE GPCD spreadsheet (version 2-05). Figure 10 presents current and projected single-family residential GPCD water use. Figure 11 presents average single-family residential GPCD use by month (also see Appendix L). Single-family residential use represents about half of total use in Las Cruces (Fig. 12).

Table 7. City of Las Cruces single-family residential GPCD water use

year	single-family residential GPCD	reduction in single-family residential GPCD with respect to 2010-2014 average value
2009	132	-
2010	125	-
2011	133	-
2012	126	-
2013	123	-
2014	119	-
2015	114	-
2009-2015 average	125	-
2015	125	0
2020	122	3
2025	118	7
2030	115	10
2035	112	13
2040	109	16
2045	106	19
2050	103	22
2055	100	25

GPCD - gallons per capita per day

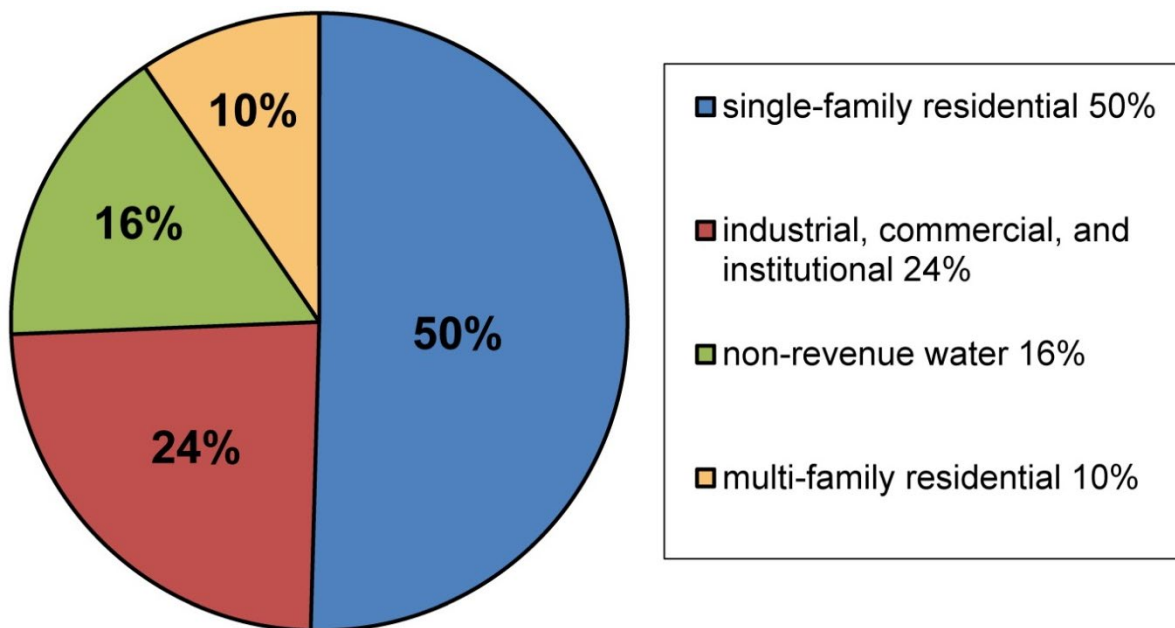


Figure 12. Chart summarizing City of Las Cruces average (2010 to 2014) water use.

Las Cruces has the goal of reducing single-family residential GPCD use to 100 GPCD by 2055 (Table 7). This savings of 25 GPCD in terms of single-family residential GPCD translates to a 17 GPCD savings in terms of total GPCD. Thus, the City’s goal for reducing total GPCD use over the next 40 years will be accomplished in part through the reduction of single-family residential GPCD water use.

The City’s single-family residential water use in summer (June, July, and August) is, on average, more than double the single-family residential water use in winter (November, December, January, February, and March) (Fig. 11; Appendix L), due to the City’s semi-arid to arid climate (Appendix M) and the resultant landscape irrigation and use of evaporative coolers in summertime.

3.4 Water Demand Projections

Water demand projections for years 2015 through 2055 presented in Table 8, in terms of total diversions, are based on projected population growth and projected total GPCD use.

Figure 13 presents a graph of projected demand from 2015 to 2055, under low- to high-growth scenarios, and the City’s groundwater rights and permits. Figure 13 shows that, under the high-growth scenario, diversions will exceed the LRG-430 et al. pre-basin right plus East and West Mesa permits at the end of the 40-year planning period, and approach the City’s total groundwater rights and permits.

During the 40-year planning period, LCU aims to develop an alternate supply up to the amount 44,207 ac-ft/yr to meet current and future demand in the case that activities in the Lower Rio Grande Basin pose challenges to using existing rights and permits to meet demand.

**Table 8. City of Las Cruces water demand projections
[projected population * projected total GPCD water use]**

year	high growth, ac-ft/yr	medium growth, ac-ft/yr	low growth, ac-ft/yr
2015	22,133	22,133	22,133
2020	24,186	23,601	23,145
2025	26,404	25,143	24,145
2030	28,797	26,759	25,057
2035	31,440	28,508	25,915
2040	34,293	30,343	26,672
2045	37,364	32,262	27,365
2050	40,666	34,264	28,044
2055	44,207	36,347	28,705

ac-ft/yr - acre-feet per year

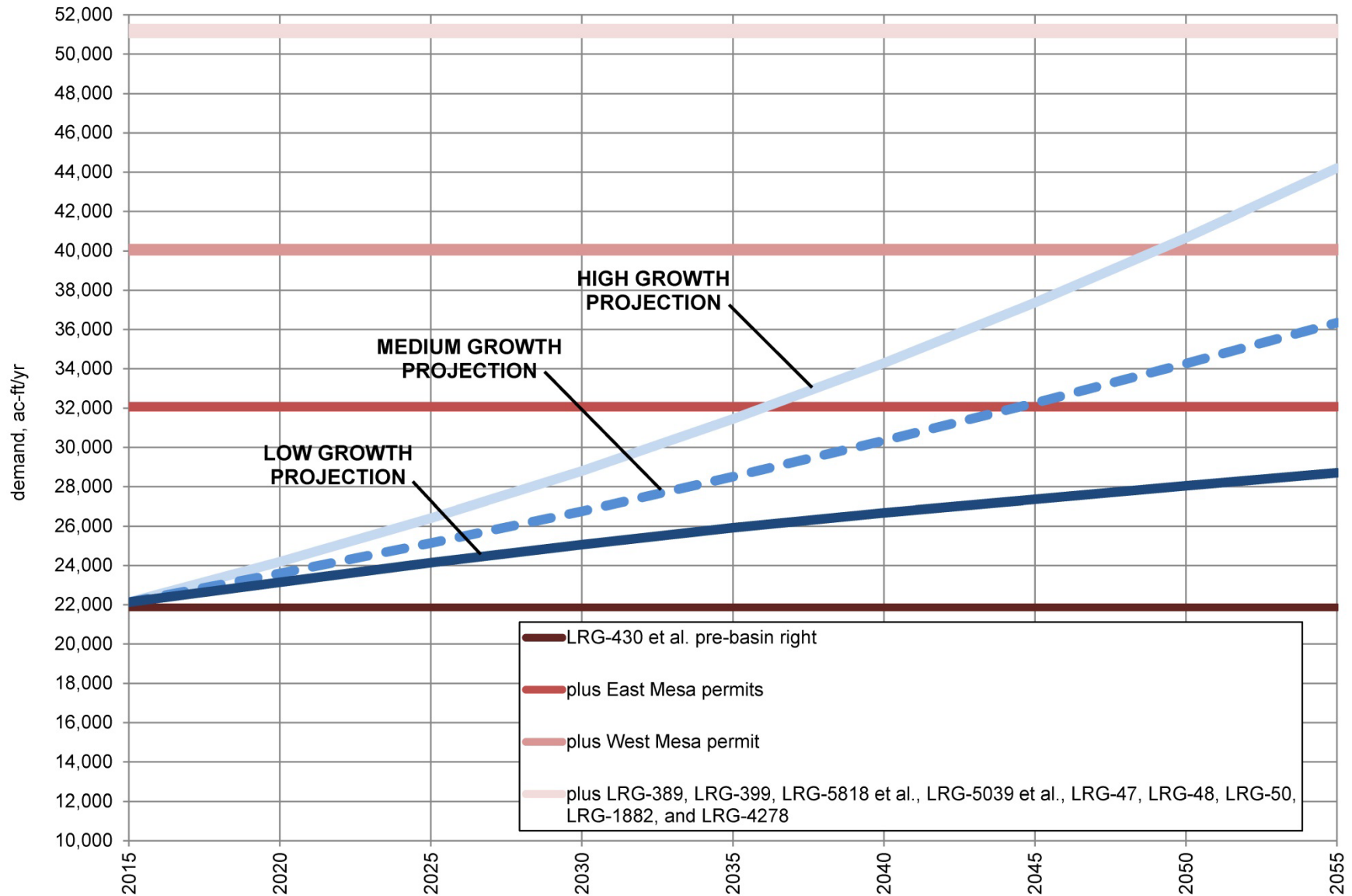


Figure 13. Graph showing City of Las Cruces projected water demands for 2015 to 2055 under low to high growth rate scenarios, City’s total existing adjudicated water rights, and existing permits.

3.5 Non-Revenue Water

Non-revenue water is defined by the AWWA water balance (Table 9). Between 2010 and 2015, Las Cruces' non-revenue water represented about 15 percent of total diverted water (Table 10; also see AWWA water audit worksheets completed annually for LCU and included in Appendix P: Water Conservation Plan). The City's Infrastructure Leakage Index (ILI) is about 3.40, which is typical for a community the size of Las Cruces in the United States, with existing water supply infrastructure capable of meeting long-term demand as long as reasonable leakage management controls are in place.

Non-revenue water numbers may be somewhat elevated due to water system flushing, hydrant flushing, and fire protection field testing (unbilled authorized deliveries, see Table 9). These flushing processes represent important preventive maintenance, remove sediment from lines, and are critical to fire protection. These processes are described in the City's Standard Operating Procedure on Hydrants Flushing, included as Appendix N. Some hydrant flushing is performed for the City's iron and manganese program. Although not required by law, LCU chlorinates the water supply to eliminate any potential issues with coliform bacteria; however, even a tiny amount of chlorine can cause iron and manganese to drop out of solution in the water, turning it red. Although there are no health risks associated with the red water, LCU has a program to address it, which involves a fire hydrant flushing procedure in affected areas. Details are included in the LCU Red Water Fact Sheet, included in Appendix N.

The City is utilizing the highest and best technology available and economically feasible for the intended use to ensure conservation of water to the maximum extent practical. In order to reduce non-revenue water, the City operates an advanced supervisory control and data acquisition system (SCADA) with redundant flow meters at a number of locations, and conducts numerous water and wastewater system rehabilitation projects. The City has performed global positioning system (GPS) addressing of utility meters to help locate leaks more quickly, and has implemented enhanced meter calibration and automatic meter reading (AMR). A water metering program has been implemented recently on most water production and waterline maintenance trucks, to track non-revenue water. Another effort to account for non-revenue water is a pilot program to log water consumption from the Fire Department Training Facility and hose-testing hydrants, as well as water meters on hydrants used for field construction. Annual water and wastewater rehabilitation expenditures planned through 2021 range from \$7.7 to \$15.9 million. Table 11 presents the details of the City's 5-Year Capital Improvement Program for water and wastewater rehabilitation.

AWWA has set an industry standard goal of less than 10 percent for water losses (AWWA, 1996). The City has the goal of reducing non-revenue water from 15 percent of total diversions to 9 percent of total diversions by 2055 through water and wastewater system rehabilitation. This reduction of non-revenue water would translate to a reduction of 8 GPCD in terms of total GPCD.

Table 9. American Water Works Association (AWWA) water balance

total water diverted	authorized deliveries	billed authorized ^a	billed metered	revenue	
			billed unmetered		
		unbilled authorized ^b	unbilled metered		non-revenue
			unbilled unmetered		
	water losses	apparent losses ^c	unauthorized		
			customer metering inaccuracies		
			systematic data handling errors		
		real losses ^d	leakage on transmission and/or distribution lines		
leakage and overflows at Utility storage tanks					
leakage on service connections					

^a examples include metered deliveries for residential, industrial, commercial, and institutional use, and park and golf course irrigation

^b examples include metered main flushing, sewer cleaning, potable well flushing, non-potable production

^c examples include theft and vandalism, customer metering inaccuracies, and data handling errors

^d examples include line leakage, and storage tank leakage and overflow

Table 10. City of Las Cruces non-revenue water and total water losses

year	total diversions, ac-ft/yr	authorized deliveries, ^a ac-ft/yr	non-revenue water, ac-ft/yr	percentage of diversion that represents non-revenue water	water losses, ac-ft/yr	percentage of diversion that represents water losses	ILI ^b
2010	20,235	17,194	3,208	16	3,041	15	4.24
2011	21,796	18,487	3,444	16	3,309	15	3.73
2012	20,626	17,260	3,464	17	3,366	16	3.69
2013	19,540	17,268	2,302	12	2,272	12	2.12
2014	19,760	16,543	3,241	16	3,217	16	3.36
2015	19,430	16,674	2,892	15	2,756	14	3.28
average	20,231	17,238	3,092	15	2,994	15	3.40

^a includes billed (account and bulk sales) and unbilled (main flushing, sewer cleaning, potable well flushing, non-potable production) metered deliveries

^b ILI = Infrastructure Leakage Index (real losses / unavoidable annual real losses)
ac-ft/yr - acre-feet per year

**Table 11. Summary of City of Las Cruces 5-Year Capital Improvement Program
for water and wastewater rehabilitation**

rehabilitation project	fiscal year expenditures, millions of U.S. dollars					
	2016 (funded)	2017	2018	2019	2020	2021
drill replacement wells	2.896	1.846	-	-	-	-
line extension	0.655	-	-	-	-	-
pump station for well	-	-	0.464	-	0.492	-
pump station rehabilitation	-	0.070	-	0.072	-	0.074
rehabilitate pump/PRV	-	-	-	-	-	-
reservoir rehabilitation	-	0.410	-	-	-	-
SCADA rehabilitation	0.015	0.015	-	-	-	-
street improvement projects	1.594	1.194	-	-	-	-
street utility rehabilitation	1.784	0.840	0.788	0.827	0.868	0.912
water production	-	-	-	-	-	-
water projects 2015A	8.763	8.763				
total water rehabilitation	15.707	13.138	1.252	0.899	1.360	0.986
force main rehabilitation	0.168	0.200	0.173	-	0.179	-
lift station renovations	0.330	0.330		0.340	-	0.350
line rehabilitation	0.137	0.172	0.176	0.181	0.185	0.190
line and manhole rehabilitation	0.538	0.100	0.103	0.106	0.109	0.113
East Mesa water reclamation	0.025	0.225	0.225	0.225	0.225	0.225
SCADA rehabilitation	0.150	0.100	-	-	-	-
street improvement project	1.571	1.171	-	-	-	-
street utility rehabilitation	1.591	1.591	1.639	1.688	1.739	1.791
WWTF operations	0.100	0.100	0.100	0.100	0.100	0.100
WWTF primary clarifier	1.400	1.200	-	-	-	-
WWTF rehabilitation	3.036	3.227	3.323	3.423	3.526	3.632
WWTF odor control	0.150	-	-	-	-	-
wastewater projects 2015A	5.011	5.011	-	-	-	-
total wastewater rehabilitation	14.207	13.427	5.739	6.063	6.063	6.401
total water and wastewater rehabilitation	29.914	26.565	6.991	6.962	7.423	7.387

SCADA - supervisory control and data acquisition system

WWTF - wastewater treatment facility

4.0 WATER CONSERVATION

4.1 Introduction

LCU is utilizing the highest and best technology available and economically feasible for the intended use to ensure conservation of water to the maximum extent practical. It may not be possible to meet the City's water demands by conservation alone, in the case that current and future activities in the Lower Rio Grande Basin pose challenges to using existing rights and permits to meet demand.

Las Cruces has adopted a comprehensive Water Conservation Program to ensure the long-range sustainability of the City's water supply. While other cities have successfully implemented demand-side reductions in the face of drought or emergency shortages, Las Cruces is implementing its Water Conservation Program proactively and systematically, and in a manner appropriate to the conditions and needs of the community. In 2003, Las Cruces City Council approved the Water Utility Drought and Water Emergency Response Plan (Appendix O). The City's Water Conservation Ordinance was enacted in 1999, and the Phase I 2005-2010 Water Conservation Program was approved by City Council in April 2005. In 2014, a revised and simplified version of the Water Conservation Ordinance was enacted (Appendix P), with administrative fees for violations of outdoor vegetation watering restrictions and water wasting restrictions. The LCU Water Conservation Plan was submitted to NMOSE in 2012, and an updated version is appended to this 40-year plan as Appendix P.

Future conservation measures will be chosen based on the City's needs and evaluation of the Water Conservation Program performance: specifically, shifts in metered demand in response to implementation of various conservation measures. Evaluation of long-range success of a conservation program, as acknowledged in New Mexico Administrative Code Title 17, Chapter 14, comes with the understanding that every community is unique and dynamic in its population, and commercial and industrial base, and conservation measures should be implemented in a manner that is efficient and cost-effective.

Pursuant to the NMOSE's (1999) definition of conservation, "any action that reduces the amount of water withdrawn from water supply sources, reduces consumptive use, reduces the loss or waste of water, improves the efficiency of water use, increases recycling and reuse of water, or prevents the pollution of water," the City of Las Cruces' Water Conservation Program is being

implemented in a comprehensive manner incorporating the highest levels of quantification of program performance. Methods of quantification and demand trending are being utilized to direct and maintain optimum benefits of actual water conserved with the costs of implementation to the community. Whenever possible, conservation shall be reported in terms of GPCD, yet it must also be understood that the City is engaged in best management practices that may not be quantifiable in terms of GPCD saved. Examples of best management practices that conserve water through pollution prevention include the following:

- Wellhead Protection Program
- Industrial Pollution Prevention compliance and enforcement
- Storm Water Management Plan and Ordinance
- Remediation of contaminated sites
- Solid Waste Department Recycling Program
- Las Cruces Dam Environmental Restoration Project
- Rio Grande Riparian Ecological Corridor Project

Las Cruces is committing substantial economic resources to these best management practices, which represent the City's responsibility to the protection of water resources. For example, Las Cruces is collaborating with Doña Ana County and the U.S. EPA to remediate the Griggs and Walnut groundwater tetrachloroethylene (PCE) plume. LCU Wells 18 and 27 are operating as plume capture wells. Water pumped from Wells 18 and 27 is treated and stored in a tank, and the City uses the treated water for municipal water supply; treatment system operation and reporting to the EPA is being performed voluntarily until LCU has a consent decree with EPA, and represents a positive example of proactive water management.

Las Cruces Dam Environmental Restoration Project represents a fully coordinated effort between U.S. Army Corps of Engineers, Las Cruces, and other federal, tribal, and local entities to restore over 78 acres of riparian habitat, about 4 acres of playa habitat, and construct several acres of emergent wetlands on the east side of Interstate-25 within the City limits. A limited amount of reclaimed water from the East Mesa water reclamation facility will facilitate the wetlands, and storm runoff will facilitate riparian habitat restoration, with socioeconomic and recreational benefits for the community (USACE, 2011).

Las Cruces is providing up to 15 ac-ft/yr of water under LRG-5818 et al. to Southwest Environmental Center for the Rio Grande Riparian Ecological Corridor Project, a wetland restoration project.

4.2 Baseline Water Conservation

4.2.1 Water Conservation Program

The City's Water Conservation Program works to reduce water use among city residents and customers, and within the city government, and utilizes the following components:

- Reporting
- Education and on-line resources
- Working with City departments
- Indoor efficiency
- Outdoor efficiency
- Compliance
- Planning
- Ordinances and regulations

These components to the Water Conservation Program are briefly summarized below, and described in detail in the updated version of the Water Conservation Plan appended to this 40-year plan as Appendix P.

4.2.1.1 Reporting

LCU provides GPCD water use reports and AWWA water audits to NMOSE on an annual basis.

4.2.1.2 Education and On-line Resources

The Water Conservation Program provides education programs for adults and children including Lush and Lean Workshops, Water Festival, and Demonstration Garden. The Water Conservation Program provides numerous on-line resources on the City's website (<http://www.las-cruces.org/WaterConservation>) including:

- Lush and Lean Workshops
- Water Festival
- Demonstration Garden
- Report Water Waste
- Tips for Residential Conservation
- How to Detect Leaks, and How to Read a Water Meter
- Water Efficiency Checklist
- Other Water Conservation Resources, including Calculating Water Needs of Plants, and Rainwater Harvesting Resources

4.2.1.3 Working with City Departments

The Water Conservation Program assists the Parks and Recreation Department with water conservation by providing water audits, and consulting on irrigation issues, water accounts, and level of use. The Water Conservation Program also assists with the Sustainability Program (see Section 4.2.6) and Planet Footprint, an energy and environmental scorekeeping program to which the City subscribes that monitors the City's electric, gas, and water accounts.

4.2.1.4 Indoor Water Efficiency

The Water Conservation Program performs informal water audits for LCU customers with high water bills, and promotes indoor water efficiency through educational programs (see Section 4.2.1.2). The Water Conservation Program has created a water efficiency evaluation form for use by homebuyers, homeowners, and inspectors.

4.2.1.5 Outdoor Water Efficiency

The Water Conservation Program performs informal water audits for LCU customers with high water bills, and promotes outdoor water efficiency practices such as use of Smart irrigation controllers and calculation of water needs of plants (on-line resources provided, see Section 4.2.1.2). The City's Demonstration Garden is an educational tool for promoting outdoor water efficiency.

4.2.1.6 Compliance

The Water Conservation Program assists with compliance to the City's water-conserving ordinances and regulations by publicizing the watering rules, receiving calls from community members reporting water wasting, and providing field staff to observe and record violations, and actively monitor problematic sites. Water Conservation Program staff encourage responsible parties to fix problems, and administer notices of violation and fees where called for, variances for special situations, and appeals to fees.

4.2.1.7 Planning

The Water Conservation Program provides input and helps develop planning documents related to water conservation including:

- Water Conservation Plan
- Drought and Water Emergency Response Plan
- Regional Water Plan
- City Comprehensive Plan
- 40-Year Water Development Plan

4.2.1.8 Ordinances and Regulations

The Water Conservation Program has provided input and helped to develop the City's Water Conservation Ordinance, and helps with evaluation of proposed legislation.

4.2.2 Water Conservation Ordinance

The City's current Water Conservation Ordinance was adopted in August 2014. To review the entire Water Conservation Ordinance, refer to Appendix P. It includes an odd/even address watering schedule, and restrictions on daytime landscape watering between April 1 and September 30. Violators of the Water Conservation Ordinance are subject to progressively higher administrative fees until the violation ceases or until a variance is granted. Administrative fees are assessed on active City utility accounts. In lieu of paying the first administrative fee, the responsible person may have a landscape water audit performed by an authorized irrigation auditor.

4.2.3 Design Standards and Storm Water Ordinances

The City's Design Standards (Land Development Code, Chapter 32) include requirements for urban drainage, soils, plant materials, and erosion control. The City's Storm Water Management code (Land Development Code, Chapter 34, Article III) promotes the elimination or reduction of pollutants from entering the city's municipal separate storm sewer system, control over discharges to and from the system, and quality of surface water and groundwater within the City limits. The Storm Water Management code includes numerous prohibitions and requirements related to discharges, release reporting and cleanup. The Storm Water Management code also prohibits the installation of impervious underlayment for landscaping related uses.

4.2.4 Water Reclamation

The City currently practices wastewater reclamation on the East Mesa and on the West Mesa. The East Mesa water reclamation facility is used to collect wastewater from interceptors serving the East Mesa, High Range, and Sonoma Ranch area, and produces very high quality reclaimed water for landscape irrigation, dust suppression, supply to purple fire hydrants, and potential supply to a future aquifer storage and recovery project. Customers include the Sonoma Ranch Golf Course, Veteran's Park, Sagecrest Park, the closed Foothills Landfill, the City compost operation, Las Cruces Dam Environmental Restoration Project, and Centennial High School. The facility has the capacity to treat 1,000,000 gallons per day. Peak summer demand from the facility is currently about 710,000 gallons per day; however, the facility must ramp down in winter when there is very little demand for the water.

On the West Mesa, reclaimed water is treated at the West Mesa wastewater treatment plant and used for sprinkler-irrigation of native vegetation in the West Mesa Industrial Park. The facility has the capacity to treat 400,000 gallons per day, and is currently operating below design capacity.

4.2.5 Water Rates

The City's current water rate structure represents a cost-of-service pricing program and is not considered a primary conservation tool, although the single-family residential rate increases above the 3,000-gallon volume threshold, and summer rates are higher (City of Las Cruces, 2015). Under the cost-of-service pricing program, single-family residential rates are \$0.70 per 1,000 gallons per month (gal/mo) of water up to 3,000 gallons, and \$2.08 per 1,000 gallons above 3,000 gal/mo during the summer period (June through September; \$1.89 per 1,000 gallons above 3,000 gal/mo during the non-summer period). To review rates for commercial, industrial, multi-unit, parks, and bulk water categories, refer to Appendix P.

4.2.6 Sustainability Program

The City's Sustainability Program draws from a well-established sustainability framework, the Triple Bottom Line, designed to help organizations balance economic vitality, environmental health, and social responsibility. It is a departure from making decisions based solely on the financial bottom-line and reflects a greater awareness of the impacts of decisions on the

environment, society and the economy. The City's Sustainability Action Plan, adopted by the City Council in June 2014, includes the following water-related 3-year objectives for the Sustainability Program:

- Monitor water consumption in City facilities and other operations to identify variances monthly for departmental review
- Reduce water consumption in City buildings, parks, and operations by 3 percent of the end of 2013 baseline rate
- Continue reduction of non-revenue water from end of 2013 baseline level
- Increase green infrastructure capabilities in four City-owned properties
- Put into place mechanisms to fulfill new National Pollutant Discharge Elimination System permit requirements

These objectives involve collaboration of numerous City departments including LCU, Public Works, Parks and Recreation, Information Technology, Fire, Police, and Community Development.

4.3 Water Conservation Plan

The LCU Water Conservation Plan was submitted to NMOSE in 2012, and an updated version is appended to this 40-year plan as Appendix P. The Water Conservation Plan aims to meet the City's conservation goals, and meet conditions of approval associated with the City's water rights permits.

The Water Conservation Plan indicates evaluation, continuation, modification, or update of the baseline water conservation measures described above in Section 4.2. Some baseline measures are relatively new; for example, the process of assessing administrative fees for violations of the water conservation ordinance was adopted in 2014, and the full impact of this measure has not yet been realized. The new process of assessing administrative fees also offers the opportunity to establish a database of repeat offenders. Water efficiency and leak detection audit was implemented as a voluntary conservation measure beginning in October 2011. Thus, baseline measures have contributed to increased water conservation as customers have become aware of these measures; this allows LCU the opportunity for outreach and education to individual customers based on data.

The Water Conservation Plan evaluates baseline and past water conservation measures, and is used to determine whether they are working, need adjustment or modifications, and provides for recommendations and improvements. For example, the odd/even address watering schedule and the daytime landscape watering restrictions from April 1st through September 30th, are working as effective conservation measures to control peak water demand. The educational and outreach programs are working, and are continually being extended to homeowners, commercial and industrial customers, youth and seniors to encourage water conservation.

The Water Conservation Plan identifies numerous voluntary, mandatory, and supply-side conservation measures to be maintained, enhanced, and evaluated to meet conservation goals over the 40-year planning period.

4.4 Meeting Total GPCD Goals

Total GPCD water use goals will be met by implementation of the Water Conservation Program, which aims at reducing single-family residential GPCD, working with industrial, commercial, and institutional customers, conservation at City facilities, and reducing total non-revenue water. A savings of 25 GPCD in terms of single-family residential GPCD, translates to a 17 GPCD savings in terms of total GPCD; thus, the City's goals for reducing total GPCD use over the next 40 years will be accomplished in part through the reduction of single-family residential water use. In addition, the City's goal of reducing total non-revenue water to 9 percent of total diversions, translates to a reduction of 8 GPCD in terms of total GPCD; thus, the City's goal for reducing total GPCD use over the next 40 years can also be accomplished in part through the reduction of non-revenue water. Additional GPCD savings will be achieved through the Water Conservation Program by working with industrial, commercial, and institutional customers, and through conservation at City facilities.

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APPENDICES

Appendix A.
LRG-430 Subfile Order

Appendix B.

**LRG-3283 through LRG-3285 and LRG-3288 through
LRG-3296 East Mesa Permits**

Appendix C.

LRG-3275 et al. West Mesa Permit

Appendix D.
Background on Surface-Water Resources

Appendix E.
Background Hydrogeology of the Mesilla Basin

Appendix F.

Background Hydrogeology of the Jornada del Muerto Basin

Appendix G.
Existing Wells

Appendix H.
Return Flow Plan

Appendix I.

LRG-389 and LRG-399 Permit Approval and Water Rights Transfers

Appendix J.

**LRG-5818 et al. Permit, Southwest Environmental Center Water Use
Under LRG-5818 et al.**

Appendix K.
LRG-5039 et al. Permit

Appendix L.

**NMOSE GPCD Calculator Spreadsheet, version 2-05, with
Las Cruces data from 2009 to 2015**

Appendix M.

Climate

Appendix N.

Water Distribution/Production Standard Operating Procedure on Hydrants Flushing, Las Cruces Utilities (LCU) Red Water Fact Sheet

Appendix O.
Drought and Water Emergency Response Plan

Appendix P.

Water Conservation Ordinance, water rates, and Water Conservation Plan

Appendix Q.

LRG-47 et al., LRG-48 et al., LRG-50 et al., LRG-1882 et al., and LRG-4278 Permits