Oklahoma Comprehensive Water Plan
2012 Update

Water Demand Forecast Report

Revised March 2011

This study was funded through an agreement with the Oklahoma Water Resources Board under its authority to update the Oklahoma Comprehensive Water Plan, the state's long-range water planning strategy, due for submittal to the State Legislature in 2012. Results from this and other studies have been incorporated where appropriate in the OCWP's technical and policy considerations. The general goal of the OCWP is to ensure reliable water supplies for all Oklahomans through integrated and coordinated water resources planning and to provide information so that water providers, policy-makers, and water users can make informed decisions concerning the use and management of Oklahoma's water resources.

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Acronyms

AEO	Annual Energy Outlook
AF	acre-feet
AFY	acre-feet per year
AHC	American Horse Council
BIA	Bureau of Indian Affairs
BLS	Bureau of Labor Statistics
BOR	Bureau of Reclamation
CDM	Camp Dresser & McKee Inc.
EIA	Energy Information Administration
ged	gallons per employee per day
ghd	gallons per head per day
GWh	gigawatt-hours
M&I	municipal and industrial
mgd	million gallons per day
MW	megawatts
MWh	megawatt-hour
NAICS	North American Industrial Classification System
NASS	National Agricultural Statistics Service
NRCS	National Resource Conservation Service
NRW	non-revenue water
OCC	Oklahoma Corporation Commission
OCWP	Oklahoma Comprehensive Water Plan
ODOC	Oklahoma Department of Commerce
OESC	Oklahoma Employment Security Commission
OGE	OGE Energy Corporation
OIPA	Oklahoma Independent Petroleum Association
OML	Oklahoma Municipal League
ORWA	Oklahoma Rural Water Association
OWRB	Oklahoma Water Resources Board
PT	provisional temporary
QCEW	Quarterly Census of Employment and Wages
rgpcd	residential gallons per-capita per day
SESAs	State Employment Security Agencies
SIC	Standard Industrial Code
UAW	unaccounted for water
UCFE	Unemployment Compensation for Federal Employees
USACE	U.S. Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	U.S. Geological Survey
WFAE	weighted field application efficiencies

Section 1
Introduction

In 1974, the Oklahoma Legislature enacted 82 O.S. §1086.2(1), which requires that the Oklahoma Water Resources Board (OWRB) develop a strategic guide for managing the state's water resources over the next 50 years. The Oklahoma Comprehensive Water Plan (OCWP) was first published in 1974, with subsequent updates in 1980 and 1995. The Oklahoma Legislature appropriated funds for the current update due in 2011.

In accordance with Task 1A.8 of the OCWP Programmatic Work Plan (updated February 2009), a water demand forecast at the county level was prepared and is documented herein. This technical document describes the efforts undertaken to collect data needed for the demand forecast, the methodologies employed to produce a reliable county-level demand forecast, and the results of the county-level forecast.

Also required under Task 1 of the OCWP Programmatic Work Plan is a municipal and industrial (M&I) demand forecast estimated for water providers in Oklahoma. This report does not include information on the provider-level forecasts; those forecasts will be documented separately.

The demand forecast produced in Task 1 has been allocated to watershed basins to characterize any differences between water supply and water demand, thus identifying areas of potential water surplus and shortfalls, or gaps. This is in accordance with Task 2 of the OCWP Programmatic Work Plan. This report does not include information on the basin-level forecasts. Those forecasts are documented in the Demand/Supply Gap report.

1.1 General Methodology

Water demand projections for all major water users throughout the state were developed for the *base year*, or starting point of the forecast (generally 2007) and then at 10-year intervals from 2010 to 2060. Water users are grouped into four major categories—publically supplied M&I, self-supplied residential, self-supplied nonresidential, and agriculture. The demand forecast is estimated by sub-categories as follows:

- Publically-supplied M&I
  - Residential
  - Nonresidential
- Self-supplied residential
- Self-supplied nonresidential
  - Thermoelectric power
  - Oil and gas
  - Other large industries
- Agriculture
  - Livestock
  - Crop irrigation

The basic methodology is to estimate water demand separately for each water use category, also referred to as a water use sector. The methodology selected to forecast any demand is commonly determined by data availability. This is the case for all sectors of the OCWP forecast.

For each sector, the basic methodology for estimating water demand is the *driver times rate of use* approach. The *driver* is defined as a countable unit driving water demands up and down, which can be projected in future years, such as number of households and people, number of acres irrigated, number of employees in a business, etc. The *rate of use* is defined as the quantity of water used by the driving unit, such as gallons per household per day or acre-feet (AF) per irrigated acre.

As shown in Figure 1, the driver, or demographic unit, and the corresponding water use rate can be defined independently for each sector. The selection of the appropriate unit and the corresponding water use rate depends upon the data available for each sector.

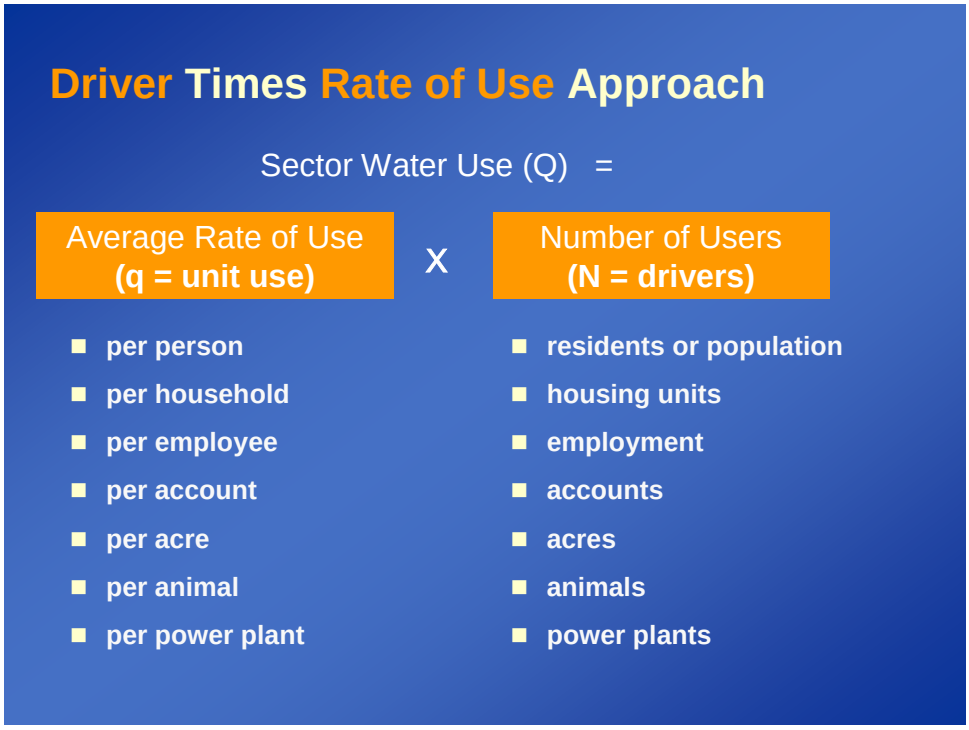

Figure 1 - Driver Times Rate of Use Approach

The per unit water use rate, or water use factor, can be developed for most sectors given historical or current water use data and a defined demographic unit. Projection of future water demand then requires having projected values of the defined demographic unit.

With this approach, the water use factor of each sector can be assumed to either remain constant into the future, decrease over time due to increases in water use efficiency, or increase over time due to more intensive water use. While trends in future water use can be difficult to know with certainty, reasonable assumptions can be made that provide the

foundation for estimating trends in the future and scenarios can be developed that consider demands under potential alternative conditions.

For all water users, total withdrawals or diversions are developed and presented in this report. *Total withdrawals* represents the amount of water pumped or diverted from the source to meet the needs of the user. In nearly all instances, some proportion of water is returned to the stream flow or released back into the ground. The difference between withdrawals and returns are referred to as *consumptive use*. For the thermoelectric power sector, consumptive demands are a small fraction of total withdrawals; thus, both sets of demands are provided in this report for that sector.

1.2 Document Organization

In order to collect data for both the demand projections and the supply gap analysis, a survey was distributed to water providers throughout the state, as discussed in Section 2. The data methodologies and results of the public supply forecast are discussed in Section 3. This is followed by a discussion of the self-supplied residential and self-supplied industrial forecasts in Section 4. This includes forecasts for thermoelectric power generation, oil and gas industry, and other self-supplied large industries. In Section 5, agriculture demands are discussed, including water demands for livestock and crop irrigation. Section 6 presents all forecast assumptions, the aggregated county forecast for all sectors, and a list of recommendations for future demand forecasts.

Finally, Appendix A contains a data log that summarizes the data sources used for the demand forecast. Appendix B contains the county-level demands with population and employment projections listed by county.

Section 2
Public Water Supplier Survey

For use in developing the OCWP, a statewide public water supply use and infrastructure survey was developed and distributed to public water systems (both municipal and rural) throughout the state. The purpose of the survey is to provide baseline information for characterizing existing conditions and future supply and infrastructure needs on an individual water provider basis. For each public water supplier, the survey identified the current service area population and demands, conservation activities, current sources of supply, existing and planned water supply and treatment infrastructure, and plans for future water supply sources, as well as other data.

The provider survey was created using SurveyMonkey.com, a powerful online survey software that allows surveys to be created, collected, and analyzed in a timely manner. The survey was created and distributed to water providers in May of 2008 through the OWRB, Oklahoma Rural Water Association (ORWA), and the Oklahoma Municipal League (OML). Results were collected through late November of 2008. Results were received online, via postal mail to the OWRB, and through the ORWA and OML.

Over 630 responses to the survey were received. While not all respondents fully completed the survey, significant data were received to provide a foundation for estimating current water demands. Responses were received from water providers representing 75 counties and 86 percent of the population across the state.

Results of the survey are used to develop the public-supply residential, public-supply nonresidential, and the self-supplied residential forecasts. Survey data used in each sector are discussed in the corresponding sections of this document. The survey is herein referenced as the 'Provider Survey.'

Section 3
Publically-Supplied Municipal and Industrial

3.1 Introduction

An important driver of water demand is population and employment. In Oklahoma, almost 92 percent of the population and nearly all commercial and light industrial establishments are serviced by public water systems. To forecast the publically-supplied M&I water demands with detail and accuracy at the county-level, this sector is grouped into two sub-sectors—public-supplied residential and public-supplied nonresidential. Each sub-sector is estimated separately because the household and businesses are driven by different water use patterns and water users.

This section describes the data, methodology, and results of the public-supply residential and nonresidential forecasts. Section 3.2 presents the public-supply residential forecast and the public-supply nonresidential forecast is discussed in Section 3.3. A summary of the publically-supplied M&I forecast is provided in Section 3.4.

3.2 Public-Supply Residential

Statewide in Oklahoma, an estimated 3.2 million people get their water from a public water supplier. The public-supplied residential demands represent the water provided to households that is used inside and outside the home for domestic activities. Indoor water uses include water for bathing, flushing, washing, drinking, etc., and capture all indoor water uses. Outdoor uses include water for landscape irrigation, car and home washing, recreation, domestic animal care, etc. Outdoor uses do not include water used for livestock or other agriculture needs, as these demands are included in the agriculture sector.

3.2.1 Methodology

For the public-supplied residential sector, the basic methodology developed for estimating future demands for each county is the average residential water use per capita times the projected population served within the county, as shown in Equation 1. Data are needed to estimate current and future water population serviced by water systems, the average per capita residential rate of use, and the percent of water lost during water production and transmission.

$$Q_{c,y}^{PSR} = \left[rgpcd_c \times P_{c,y}^{PSR}\right] \times \left[1 + \left(NRW_c/(1 - NRW_c)\right)\right] \qquad \textit{Equation 1}$$

Where:

- $Q_{c,y}^{PSR}$ = Public-supplied residential water demand including system losses in county (c) in year (y)
- $rgpcd_c$ = Weighted average residential per capita in county (c)

- $P_{c,y}^{PSR}$ = Population supplied by public system in county (c) in year (y)
- NRW_c= Percent system losses in county (c)

3.2.2 Data

For the public-supply residential forecast, data were collected and derived for the *driver*, per unit use, and system loss percentage by county. Population projections are the primary source of the *driver*. Data collected from the Provider Survey are the basis for developing the per unit use and system loss percent.

Population

The Oklahoma Department of Commerce (ODOC) prepared a special tabulation of population projections for the OWRB in 2002 that estimates population to the year 2060 for each county, city, and town, and remaining rural area within each county. These county-level projections were calibrated by CDM to match 2007 Census estimates of population. This was done to capture changes in economic growth and demographic patterns since the 2002 release. The calibration adjusted the projections to align with the most recent available data.

Both the ODOC and Census data include military populations. However, the ODOC projections do not capture plans for future base-realignments within military installations. Data were provided by Fort Sill in Comanche County on future base-realignments. The base is expecting an increase of 5,550 in soldiers and 1,075 civilian personnel from 2007 to 2014. According to Fort Sill contacts, the average soldier has 0.978 dependents. Thus, population in Comanche County is expected to increase by 13,366 in 2014, in addition to the increase projected by the ODOC. The increase includes soldiers, civilians, and soldier families. The population projections for Comanche County were adjusted accordingly.

The ODOC and Census data also capture Tribal populations[1] but not specific plans for economic growth within Tribal Nations. For example, the Chickasaw Nation is planning expansion at two locations—one in Kingston in Marshall County and the other at Thackerville in Love County. The Love County WinStar Casino is expected to employ 6,000 persons and bring 13,970 additional people to the area by 2050. While the plan does not specify a completion date, the build date of the expansion was assumed to be complete between 2010 and 2020. The population projections for Love County were adjusted to capture the future growth of the WinStar Casino. For the Kingston Casino, the employment growth is less and is expected to be absorbed into the county, thus not expanding population projections. The employment projections for both counties were increased to capture the future expansion, as discussed in Section 3.3.

[1] Tribal populations do not represent tribal membership but rather the persons living in a given geography that may live on or off tribal lands. For purposes of the demand forecast, it is important that all persons living within a geographic area are counted and included in the forecast *driver*. ODOC projections of population and Census counts do include persons living on the tribal lands.

The resulting population projections, representing all persons living in the given county, are shown in Table 1. Statewide population is projected to increase by 33 percent from 2007 to 2060. The population projections shown in Table 1 are further identified as "self-supplied" and "public-supplied," as shown in Figure 2 and discussed below.

Table 1 - Total Population Projections by County

County	2007	2010	2020	2030	2040	2050	2060
Adair	21,902	22,962	26,773	30,585	34,396	38,301	42,205
Alfalfa	5,593	5,537	5,537	5,537	5,537	5,631	5,724
Atoka	14,512	15,036	16,879	18,722	20,565	22,602	24,639
Beaver	5,380	5,435	5,527	5,620	5,712	5,804	5,896
Beckham	19,700	20,212	22,015	23,913	25,811	27,709	29,797
Blaine	12,475	12,717	13,827	15,039	16,250	17,461	18,773
Bryan	39,563	40,827	45,040	49,353	53,667	57,980	62,394
Caddo	29,296	29,584	30,833	31,793	32,754	33,714	34,579
Canadian	103,559	106,854	117,286	125,413	132,441	138,921	145,510
Carter	47,582	48,254	51,104	53,853	56,500	59,350	62,404
Cherokee	45,393	47,663	54,755	61,753	68,846	75,750	82,842
Choctaw	15,011	15,127	15,515	15,806	16,194	16,582	16,970
Cimarron	2,664	2,664	2,831	2,914	2,914	2,997	3,080
Cleveland	236,452	243,459	261,555	276,180	287,858	296,065	304,061
Coal	5,709	5,869	6,758	7,648	8,626	9,693	10,760
Comanche	113,811	128,490	137,442	144,210	149,473	153,609	156,993
Cotton	6,299	6,357	6,453	6,549	6,646	6,838	6,935
Craig	15,195	15,650	17,358	18,970	20,772	22,574	24,471
Creek	69,073	70,543	75,441	79,262	82,888	86,513	90,432
Custer	26,111	26,571	27,818	28,970	30,121	30,984	31,751
Delaware	40,406	42,276	48,608	54,745	61,077	67,895	75,006
Dewey	4,338	4,338	4,244	4,244	4,244	4,338	4,432
Ellis	3,911	3,850	3,749	3,749	3,648	3,648	3,749
Garfield	57,657	58,128	59,896	61,369	62,743	63,823	65,100
Garvin	27,141	27,260	27,954	28,449	28,945	29,540	30,135
Grady	50,615	51,761	55,473	58,655	61,519	64,382	67,352
Grant	4,497	4,497	4,585	4,673	4,673	4,850	4,938
Greer	5,810	5,810	5,810	5,810	5,908	6,007	6,105
Harmon	2,837	2,890	2,890	2,977	3,065	3,152	3,240
Harper	3,254	3,198	3,198	3,198	3,198	3,292	3,292
Haskell	12,059	12,561	14,236	16,004	17,865	19,726	21,773
Hughes	13,680	14,167	15,792	17,416	19,130	21,025	22,920
Jackson	25,778	26,249	27,819	29,127	30,173	31,045	31,743
Jefferson	6,273	6,273	6,368	6,463	6,558	6,748	6,938
Johnston	10,402	10,735	12,031	13,419	14,807	16,288	17,861
Kay	45,638	45,975	47,567	48,784	49,908	51,031	52,249
Kingfisher	14,320	14,784	16,523	18,262	20,002	21,741	23,673
Kiowa	9,456	9,399	9,399	9,494	9,589	9,779	9,969
Latimer	10,508	10,624	11,107	11,686	12,362	13,038	13,811
Le Flore	49,715	50,780	54,724	58,274	61,823	65,373	69,120
Lincoln	32,272	33,073	36,027	38,505	41,079	43,747	46,607
Logan	36,435	37,843	42,537	46,742	50,946	55,053	59,454
Love	9,112	9,606	25,223	26,778	28,425	30,163	31,901
Major	7,190	7,132	7,229	7,229	7,325	7,421	7,518
Marshall	14,830	15,903	19,573	23,337	27,195	31,241	35,475
Mayes	39,627	40,790	44,859	48,734	52,804	56,970	61,233
McClain	31,849	33,434	39,024	44,206	49,389	54,775	60,263
McCurtain	33,539	33,939	35,465	36,704	37,753	38,897	39,946
McIntosh	19,709	20,385	22,828	25,364	28,183	31,377	34,758

Table 1 - Total Population Projections by County

County	2007	2010	2020	2030	2040	2050	2060
Murray	12,695	13,035	14,169	15,491	16,719	18,136	19,553
Muskogee	71,116	71,662	74,088	76,311	78,232	80,152	82,072
Noble	11,124	11,293	11,858	12,235	12,611	12,893	13,176
Nowata	10,723	11,170	12,752	14,335	15,917	17,592	19,361
Okfuskee	11,248	11,305	11,590	11,875	12,160	12,445	12,825
Oklahoma	701,807	713,774	748,374	779,107	802,309	819,202	835,892
Okmulgee	39,300	40,100	43,053	45,625	48,292	51,054	53,816
Osage	45,523	46,462	49,788	52,233	54,483	56,733	59,276
Ottawa	32,474	32,984	35,253	37,426	39,789	42,246	44,704
Pawnee	16,447	16,950	18,813	20,489	22,258	24,121	25,984
Payne	79,931	82,684	88,978	95,593	102,101	106,688	111,063
Pittsburg	44,711	45,190	47,285	49,080	51,175	53,569	56,163
Pontotoc	36,571	36,999	38,426	39,751	41,076	42,299	43,522
Pottawatomie	69,038	70,426	75,256	79,783	84,109	88,335	92,762
Pushmataha	11,666	12,055	13,632	15,116	16,692	18,454	20,216
Roger Mills	3,308	3,308	3,308	3,308	3,308	3,308	3,308
Rogers	83,105	86,272	96,934	106,089	114,598	123,322	132,261
Seminole	24,179	24,353	25,126	25,803	26,479	27,252	28,025
Sequoyah	41,024	42,368	46,946	51,231	55,419	59,705	63,990
Stephens	43,322	43,322	43,827	44,231	44,736	45,443	46,352
Texas	20,032	21,557	26,802	32,130	37,458	42,785	48,031
Tillman	8,148	8,148	8,325	8,502	8,679	8,857	9,122
Tulsa	585,068	595,326	627,632	654,571	673,557	687,970	701,986
Wagoner	67,239	69,679	77,814	84,557	90,765	96,866	103,288
Washington	49,888	50,130	51,240	51,744	52,450	53,156	53,963
Washita	11,667	11,786	12,182	12,479	12,677	12,974	13,172
Woods	8,319	8,374	8,374	8,465	8,556	8,647	8,829
Woodward	19,505	19,752	20,575	21,192	21,604	22,118	22,530
Statewide Total	**3,617,316**	**3,707,936**	**3,977,882**	**4,205,238**	**4,410,513**	**4,601,768**	**4,796,019**

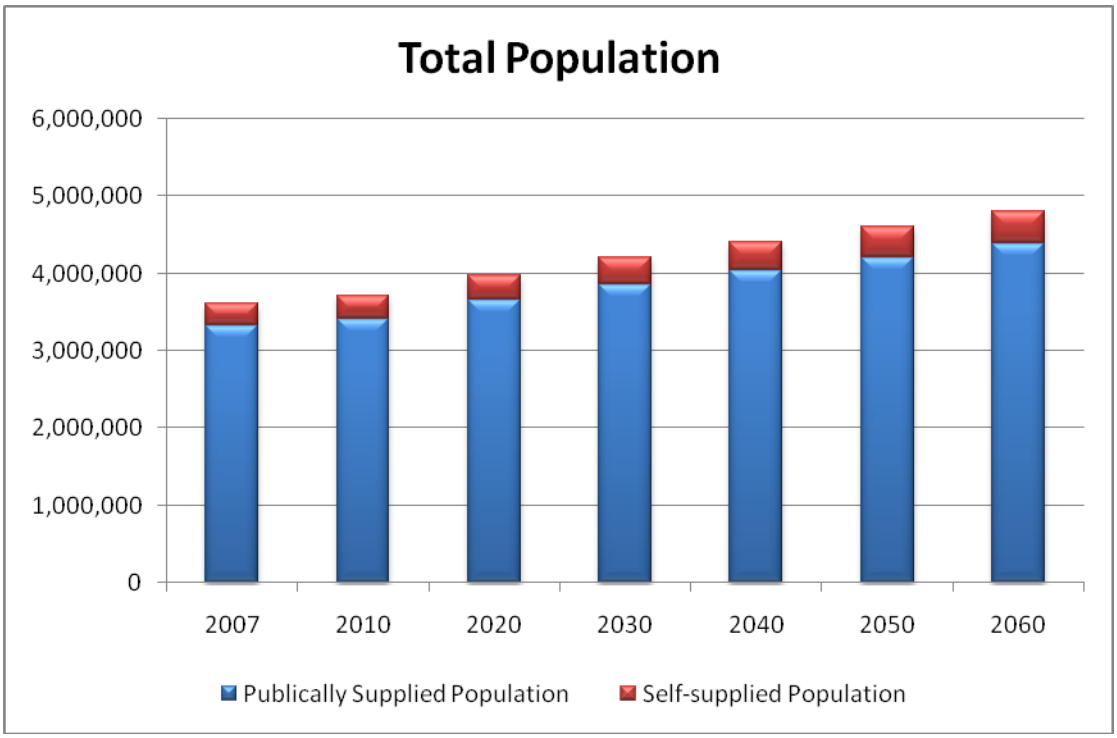

Figure 2 - Total Population

For the public-supplied residential forecast, the public-supplied portion of total county population projections is identified and only that portion is used in the forecast. Public-supplied population is the number of persons living in households that have water piped to their home from a water provider (versus households that have private wells). Population is split between public-supplied and self-supplied population using the U.S. Geological Survey (USGS) 2005 estimated population on private wells by county for Oklahoma. The USGS preliminary numbers were used to allocate the 2007 population projections between public-supplied and self-supplied. The ratio of public-supplied to self-supplied population for each county is assumed to remain constant into the future. The public-supplied population projections are shown in Table 2. Self-supplied population projections are presented in Section 4.2. Given these assumptions, the statewide public-supplied population is expected to increase by 32 percent from 2007 to 2060.

Table 2 - Public-Supplied Population Projections by County

County	2007	2010	2020	2030	2040	2050	2060
Adair	12,762	13,380	15,600	17,821	20,042	22,317	24,592
Alfalfa	4,733	4,685	4,685	4,685	4,685	4,765	4,844
Atoka	11,482	11,896	13,355	14,813	16,271	17,883	19,495
Beaver	2,760	2,788	2,836	2,883	2,930	2,977	3,025
Beckham	17,720	18,181	19,803	21,510	23,217	24,924	26,802
Blaine	11,345	11,565	12,575	13,676	14,778	15,879	17,073
Bryan	36,783	37,958	41,875	45,885	49,896	53,906	58,010
Caddo	17,566	17,739	18,487	19,063	19,639	20,215	20,734
Canadian	103,559	106,854	117,286	125,413	132,441	138,921	145,510
Carter	47,362	48,031	50,868	53,604	56,239	59,076	62,116
Cherokee	37,963	39,861	45,793	51,645	57,577	63,351	69,282
Choctaw	10,311	10,391	10,657	10,857	11,124	11,390	11,656
Cimarron	1,544	1,544	1,641	1,689	1,689	1,737	1,785
Cleveland	223,782	230,414	247,540	261,381	272,434	280,200	287,768
Coal	4,139	4,255	4,900	5,544	6,254	7,027	7,801
Comanche	111,621	126,017	134,797	141,435	146,597	150,653	153,972
Cotton	6,299	6,357	6,453	6,549	6,646	6,838	6,935
Craig	14,395	14,826	16,444	17,971	19,679	21,386	23,183
Creek	62,023	63,343	67,741	71,172	74,428	77,683	81,202
Custer	22,791	23,193	24,281	25,286	26,291	27,044	27,714
Delaware	28,906	30,244	34,774	39,164	43,693	48,572	53,659
Dewey	3,268	3,268	3,197	3,197	3,197	3,268	3,339
Ellis	2,531	2,492	2,426	2,426	2,361	2,361	2,426
Garfield	56,197	56,656	58,379	59,815	61,154	62,207	63,451
Garvin	22,991	23,092	23,680	24,099	24,519	25,023	25,527
Grady	34,875	35,664	38,222	40,415	42,388	44,361	46,407
Grant	3,847	3,847	3,922	3,998	3,998	4,149	4,224
Greer	5,810	5,810	5,810	5,810	5,908	6,007	6,105
Harmon	2,837	2,890	2,890	2,977	3,065	3,152	3,240
Harper	2,294	2,254	2,254	2,254	2,254	2,321	2,321
Haskell	6,779	7,061	8,003	8,997	10,043	11,089	12,240
Hughes	12,740	13,194	14,706	16,219	17,816	19,581	21,345
Jackson	24,698	25,149	26,653	27,906	28,909	29,745	30,413
Jefferson	6,133	6,133	6,226	6,319	6,412	6,598	6,783
Johnston	10,292	10,622	11,904	13,277	14,651	16,116	17,672
Kay	43,398	43,719	45,232	46,390	47,458	48,527	49,684
Kingfisher	10,310	10,644	11,896	13,148	14,401	15,653	17,044
Kiowa	9,456	9,399	9,399	9,494	9,589	9,779	9,969
Latimer	9,188	9,289	9,712	10,218	10,809	11,401	12,076
Le Flore	43,355	44,284	47,723	50,819	53,914	57,010	60,277
Lincoln	14,622	14,985	16,323	17,446	18,612	19,821	21,117
Logan	25,175	26,148	29,391	32,296	35,202	38,040	41,080
Love	8,802	9,279	24,365	25,867	27,458	29,137	30,816
Major	5,100	5,059	5,127	5,127	5,196	5,264	5,332
Marshall	14,180	15,206	18,715	22,314	26,003	29,872	33,920
Mayes	39,627	40,790	44,859	48,734	52,804	56,970	61,233
McClain	24,419	25,634	29,920	33,894	37,867	41,997	46,204
McCurtain	26,049	26,360	27,545	28,507	29,322	30,210	31,025
McIntosh	19,709	20,385	22,828	25,364	28,183	31,377	34,758
Murray	12,695	13,035	14,169	15,491	16,719	18,136	19,553
Muskogee	64,266	64,759	66,951	68,961	70,696	72,432	74,167
Noble	9,604	9,750	10,238	10,563	10,888	11,132	11,375
Nowata	10,033	10,451	11,932	13,412	14,893	16,460	18,115
Okfuskee	10,148	10,199	10,457	10,714	10,971	11,228	11,571
Oklahoma	687,767	699,495	733,403	763,521	786,259	802,814	819,169

Table 2 - Public-Supplied Population Projections by County

County	2007	2010	2020	2030	2040	2050	2060
Okmulgee	39,300	40,100	43,053	45,625	48,292	51,054	53,816
Osage	38,763	39,563	42,394	44,477	46,392	48,308	50,474
Ottawa	25,484	25,885	27,665	29,370	31,225	33,153	35,081
Pawnee	11,797	12,158	13,494	14,696	15,965	17,301	18,637
Payne	72,011	74,491	80,162	86,121	91,984	96,117	100,058
Pittsburg	44,711	45,190	47,285	49,080	51,175	53,569	56,163
Pontotoc	31,081	31,445	32,658	33,784	34,910	35,949	36,989
Pottawatomie	48,208	49,177	52,550	55,711	58,732	61,683	64,774
Pushmataha	10,126	10,464	11,832	13,120	14,489	16,018	17,547
Roger Mills	2,628	2,628	2,628	2,628	2,628	2,628	2,628
Rogers	77,525	80,479	90,426	98,966	106,903	115,042	123,381
Seminole	20,199	20,344	20,990	21,555	22,120	22,766	23,412
Sequoyah	40,204	41,521	46,007	50,207	54,312	58,512	62,711
Stephens	36,702	36,702	37,130	37,472	37,900	38,499	39,269
Texas	17,432	18,759	23,324	27,960	32,596	37,232	41,797
Tillman	7,478	7,478	7,641	7,803	7,966	8,128	8,372
Tulsa	576,128	586,230	618,042	644,569	663,265	677,458	691,260
Wagoner	67,239	69,679	77,814	84,557	90,765	96,866	103,288
Washington	49,888	50,130	51,240	51,744	52,450	53,156	53,963
Washita	9,467	9,563	9,885	10,126	10,287	10,528	10,689
Woods	7,209	7,256	7,256	7,335	7,414	7,493	7,651
Woodward	16,005	16,208	16,883	17,389	17,727	18,149	18,487
Statewide Total	**3,322,626**	**3,405,974**	**3,651,204**	**3,856,335**	**4,039,962**	**4,209,587**	**4,381,585**

Water Use and System Losses

The Provider Survey collected data on annual water demand, percent of that demand that services residential homes, and retail service area population for each provider for 2007. For each utility that responded to the survey, this information was used to derive an average residential per capita water use factor, or residential gallons per capita per day (rgpcd). A weighted average of the known rgpcd was calculated for each county based on serviced population. For the two counties with no utility participation in the Provider Survey, the weighted rgpcd from an adjacent county was assumed (implying similar regional water use patterns).

Additionally, the survey collected information on the amount of water lost through system leaks. This information allows for an adjustment to the county public supply forecast that includes water lost during water production and distribution to residential homes. Specifically, the Provider Survey requested the non-revenue water (NRW) percentage for each provider. NRW is calculated as the difference between water produced and water sold as identified by billed sales. It is then divided by total water production to provide a measure of NRW as a percent of total production. The term "non-revenue water" has replaced the older term "unaccounted-for water" (UAW).

The difference between water produced and billed water sales includes authorized meter water usage that is not billed, unauthorized water use, billing errors, metering errors, line breaks, and system losses. NRW is often further separated to distinguish real water loss, such as line breaks, storage overflow, and system losses, from apparent loss, such as unmetered use, billing errors, and metering errors. Authorized unmetered water uses

include uses such as fire training, fire fighting, water line and reservoir flushing, and water used for street cleaning. Real loss as a percent of total production can usually be maintained at less than about 10 percent through system leak detection and line replacement programs.

Survey results for NRW ranged from 1 percent to over 40 percent. For purposes of the survey, any reported NRW over 15 percent was assumed to be un-metered consumption, thus the percentage was capped at 15 percent and referred to as system losses. Results of the rgpcd and system losses percentage for each county are shown in Table 3.

Table 3 - Provider Survey Results for Residential Gallons Per Capita Per Day and System Losses

County	Residential GPCD 2007	System Losses 2007
Adair	69	15%
Alfalfa	121	10%
Atoka	160	15%
Beaver	118	10%
Beckham	141	7%
Blaine	147	5%
Bryan	115	13%
Caddo	108	10%
Canadian	84	10%
Carter	90	14%
Cherokee	91	15%
Choctaw	62	15%
Cimarron	269	15%
Cleveland	91	14%
Coal	84	15%
Comanche	70	11%
Cotton	60	15%
Craig	75	15%
Creek	67	15%
Custer	118	13%
Delaware	74	15%
Dewey	219	13%
Ellis	176	15%
Garfield	114	15%
Garvin	100	15%
Grady	67	15%
Grant	107	15%
Greer	120	7%
Harmon	178	15%
Harper	253	15%
Haskell	76	15%
Hughes	79	15%
Jackson	91	15%
Jefferson	75	15%
Johnston	93	15%
Kay	73	15%
Kingfisher	119	15%
Kiowa	66	15%
Latimer	129	15%
Le Flore	76	15%
Lincoln	69	15%

Table 3 - Provider Survey Results for Residential Gallons Per Capita Per Day and System Losses

County	Residential GPCD 2007	System Losses 2007
Logan	110	15%
Love	78	15%
Major	89	13%
Marshall	78	15%
Mayes	73	15%
McClain	91	15%
McCurtain	83	15%
McIntosh	68	15%
Murray	114	14%
Muskogee	86	5%
Noble	74	13%
Nowata	63	15%
Okfuskee	77	15%
Oklahoma	69	13%
Okmulgee	177	15%
Osage	129	15%
Ottawa	88	15%
Pawnee	113	15%
Payne	73	15%
Pittsburg	89	15%
Pontotoc	92	11%
Pottawatomie	54	7%
Pushmataha	50	15%
Roger Mills	136	15%
Rogers	93	14%
Seminole	50	15%
Sequoyah	109	15%
Stephens	112	15%
Texas	117	15%
Tillman	106	13%
Tulsa	90	9%
Wagoner	80	15%
Washington	116	15%
Washita	58	11%
Woods	283	15%
Woodward	184	9%

3.2.3 Forecast

Results of the public-supplied residential forecast are shown in Table 4 for each county. Growth in counties is directly attributable to projected population growth. Statewide water demands from the public-supplied residential population are estimated to increase by 32 percent from 2007 to 2060, assuming per-capita usage and system losses remain constant for purposes of this baseline demand forecast.

Table 4 - Water Demands from Public-Supply Residential Sector Including System Losses (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Adair	1,153	1,209	1,409	1,610	1,811	2,016	2,222
Alfalfa	713	706	706	706	706	718	730
Atoka	2,424	2,512	2,820	3,128	3,436	3,776	4,116
Beaver	405	409	416	423	430	437	444
Beckham	3,001	3,079	3,354	3,643	3,932	4,222	4,540

Table 4 - Water Demands from Public-Supply Residential Sector Including System Losses (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Blaine	1,964	2,002	2,176	2,367	2,558	2,748	2,955
Bryan	5,439	5,613	6,192	6,785	7,378	7,971	8,577
Caddo	2,365	2,389	2,489	2,567	2,645	2,722	2,792
Canadian	10,892	11,239	12,336	13,191	13,930	14,612	15,305
Carter	5,514	5,592	5,922	6,241	6,547	6,878	7,231
Cherokee	4,429	4,651	5,343	6,026	6,718	7,391	8,084
Choctaw	834	840	862	878	899	921	942
Cimarron	547	547	581	598	598	615	632
Cleveland	26,529	27,315	29,345	30,986	32,296	33,217	34,114
Coal	461	473	545	617	696	782	868
Comanche	9,865	11,137	11,913	12,499	12,956	13,314	13,607
Cotton	502	507	514	522	530	545	553
Craig	1,429	1,472	1,632	1,784	1,954	2,123	2,302
Creek	5,510	5,627	6,018	6,323	6,612	6,901	7,214
Custer	3,463	3,525	3,690	3,843	3,995	4,110	4,212
Delaware	2,820	2,950	3,392	3,820	4,262	4,738	5,234
Dewey	928	928	907	907	907	928	948
Ellis	587	578	563	563	548	548	563
Garfield	8,423	8,492	8,750	8,965	9,166	9,324	9,511
Garvin	3,044	3,058	3,136	3,191	3,247	3,314	3,380
Grady	3,064	3,134	3,358	3,551	3,724	3,898	4,078
Grant	542	542	552	563	563	584	595
Greer	841	841	841	841	855	870	884
Harmon	667	679	679	700	721	741	762
Harper	765	752	752	752	752	774	774
Haskell	675	703	797	896	1,000	1,104	1,219
Hughes	1,327	1,374	1,531	1,689	1,855	2,039	2,223
Jackson	2,960	3,015	3,195	3,345	3,465	3,565	3,645
Jefferson	603	603	612	621	630	649	667
Johnston	1,264	1,305	1,462	1,631	1,799	1,979	2,171
Kay	4,203	4,234	4,381	4,493	4,597	4,700	4,812
Kingfisher	1,620	1,672	1,869	2,066	2,263	2,459	2,678
Kiowa	825	820	820	829	837	853	870
Latimer	1,558	1,576	1,647	1,733	1,833	1,934	2,048
Le Flore	4,342	4,435	4,779	5,089	5,399	5,709	6,037
Lincoln	1,325	1,358	1,479	1,581	1,687	1,797	1,914
Logan	3,651	3,792	4,263	4,684	5,106	5,517	5,958
Love	900	948	2,490	2,643	2,806	2,978	3,149
Major	580	576	584	584	591	599	607
Marshall	1,454	1,559	1,919	2,288	2,666	3,063	3,478
Mayes	3,788	3,899	4,288	4,658	5,047	5,445	5,853
McClain	2,925	3,071	3,584	4,060	4,536	5,031	5,535
McCurtain	2,841	2,875	3,004	3,109	3,198	3,295	3,384
McIntosh	1,768	1,829	2,048	2,276	2,529	2,815	3,119
Murray	1,883	1,933	2,102	2,298	2,480	2,690	2,900
Muskogee	6,483	6,533	6,754	6,957	7,132	7,307	7,482
Noble	914	928	974	1,005	1,036	1,059	1,082
Nowata	832	867	990	1,113	1,236	1,366	1,503
Okfuskee	1,028	1,034	1,060	1,086	1,112	1,138	1,173
Oklahoma	61,028	62,069	65,078	67,750	69,768	71,237	72,688
Okmulgee	9,176	9,363	10,053	10,653	11,276	11,921	12,566
Osage	6,595	6,731	7,213	7,567	7,893	8,219	8,587
Ottawa	2,949	2,996	3,202	3,399	3,614	3,837	4,060
Pawnee	1,764	1,818	2,018	2,198	2,388	2,587	2,787
Payne	6,935	7,174	7,720	8,294	8,858	9,256	9,636

Table 4 - Water Demands from Public-Supply Residential Sector Including System Losses (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Pittsburg	5,227	5,283	5,528	5,738	5,983	6,262	6,566
Pontotoc	3,605	3,647	3,787	3,918	4,049	4,169	4,290
Pottawatomie	3,129	3,191	3,410	3,616	3,812	4,003	4,204
Pushmataha	667	689	780	865	955	1,055	1,156
Roger Mills	473	473	473	473	473	473	473
Rogers	9,389	9,746	10,951	11,985	12,947	13,932	14,942
Seminole	1,331	1,341	1,383	1,420	1,458	1,500	1,543
Sequoyah	5,797	5,987	6,634	7,239	7,831	8,436	9,042
Stephens	5,435	5,435	5,498	5,549	5,612	5,701	5,815
Texas	2,678	2,882	3,583	4,295	5,007	5,719	6,421
Tillman	1,023	1,023	1,046	1,068	1,090	1,112	1,146
Tulsa	64,076	65,199	68,737	71,687	73,767	75,345	76,880
Wagoner	7,121	7,379	8,241	8,955	9,612	10,259	10,939
Washington	7,603	7,639	7,809	7,885	7,993	8,101	8,224
Washita	691	698	721	739	750	768	780
Woods	2,692	2,709	2,709	2,739	2,768	2,798	2,857
Woodward	3,617	3,663	3,815	3,930	4,006	4,101	4,178
Statewide Total	**371,870**	**380,868**	**408,215**	**431,284**	**452,118**	**471,620**	**491,449**

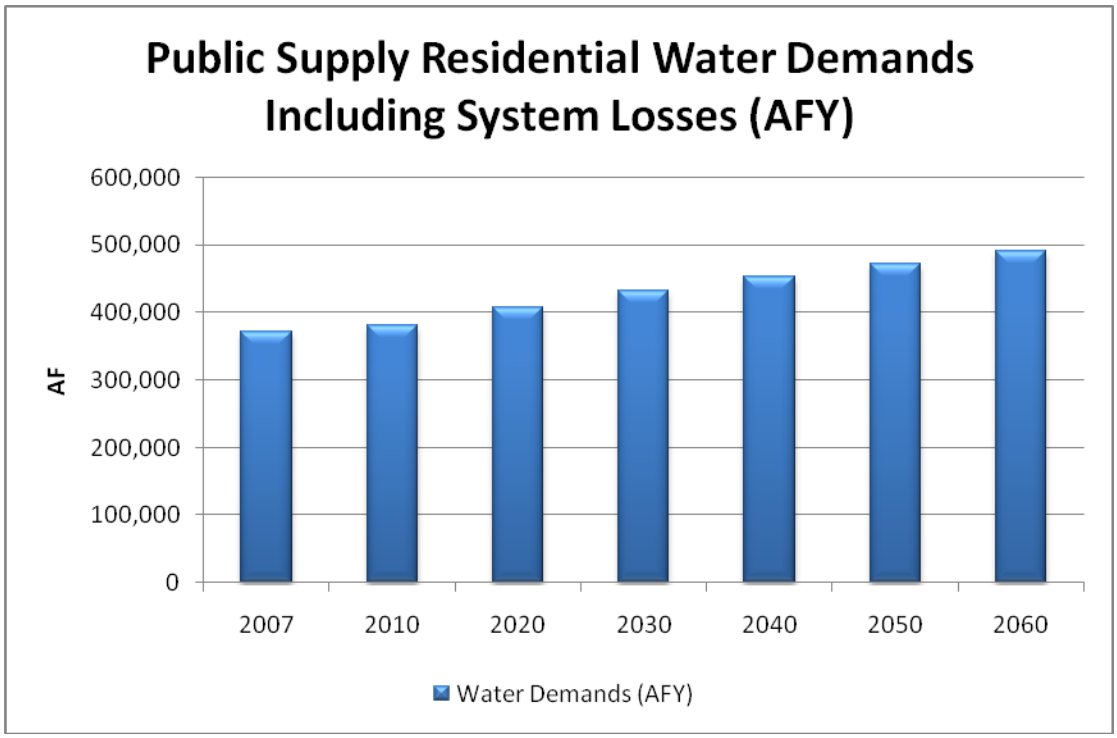

Figure 3 - Public Supply Residential Water Demands Including System Losses (AFY)

3.3 Public-Supply Nonresidential

Closely related to the public-supply residential forecast is the public-supply nonresidential forecast. Nonresidential refers to all properties other than residential housing such as office buildings, shopping centers, industrial parks, schools, churches, hotels, etc. Public-supply refers to establishments receiving water from public water systems. For purposes

of the OCWP water demand forecast, the public-supply nonresidential forecast captures water use from all nonresidential establishments other than those identified and represented in the self-supplied sector in Section 4.4. Establishments identified for the self-supplied industrial sector are removed from the public supply nonresidential forecast to avoid double-counting.

The public-supply nonresidential forecast relies on several data—employment by group and county, water use per employee by group, employment projections for Oklahoma, and the population projections previously discussed. The data, methodology, and results of the forecast are discussed in the following sections.

3.3.1 Methodology

County nonresidential water use is estimated by multiplying county employment by water use per employee. Projections of employment and water use are obtained at the most detailed level available. Both employment and water use per employee are available at the 2-digit North American Industrial Classification System (NAICS)[2] level. System loss percentages, as discussed in Section 3.2.2, are also captured in the forecast. Water use per employee is assumed to remain constant while employment grows in the future. Equation 2 provides the detailed formula for estimating water use for the public-supplied nonresidential sector.

$$Q_{c,y}^{PSNR} = \left[\sum\left(E_{c,y}^{NAICS} \times GED_{c}^{NAICS}\right)\right] \times \left[1 + \left(NRW_c/(1 - NRW_c)\right)\right] \qquad \textit{Equation 2}$$

Where:

- $Q_{c,y}^{PSNR}$ = Public-supplied nonresidential water demand including system losses in county (c) in year (y)
- $E_{c,y}^{NAICS}$ = Employment by NAICS group in county (c) and year (y)
- GED_{c}^{NAICS} = Water use per employee by NAICS group, which may be adjusted for a specific county (c)
- NRW_c= Percent system losses in county (c)

3.3.2 Data

The public-supply nonresidential forecast is driven by economic activity, which can be difficult to predict. Thus, a typical measure of nonresidential water use in forecasting is employment, which is more foreseeable. Employment projections were developed for Oklahoma by county and by employment group. The rate of water use per employee is unique to the type of establishment, e.g., water use per employee would be significantly

[2] NAICS is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

higher at a restaurant where water is being used to wash dishes and prepare food than at a bank where water use is for sanitary purposes. To account for this, per unit use factors were developed by employment group from an existing database.

Employment

County level employment data for 2006 were collected by NAICS levels from the Bureau of Labor Statistics (BLS). The BLS, along with the U.S. Department of Labor and the State Employment Security Agencies (SESAs), manage the Quarterly Census of Employment and Wages (QCEW) program. This program produces a comprehensive tabulation of employment and wage information for workers covered by state unemployment insurance laws and Federal workers covered by the Unemployment Compensation for Federal Employees (UCFE) program. Publicly available files include data on the number of establishments, monthly employment, and quarterly wages, by NAICS industry, by county, by ownership sector, for the entire United States[3]. QCEW data include all government and private employees. These data were used as the starting point for the employment projections. A sample of the QCEW data used in the employment projections is shown in Table 5 for Beckham County.

Table 5 - Sample of QCEW Data, Beckham County, Oklahoma, 2006

Ownership Title	NAICS Description	Annual Average Establishment Count	Annual Average Employment
Total Covered	10 Total, all industries	767	8,599
Federal Government	10 Total, all industries	10	50
State Government	10 Total, all industries	10	156
Local Government	10 Total, all industries	32	917
Private	10 Total, all industries	715	7,476
Private	11 Agriculture, forestry, fishing and hunting	9	52
Private	21 Mining, quarrying, and oil and gas extraction	82	1,295
Local Government	22 Utilities	4	27
Private	22 Utilities	9	75
Local Government	23 Construction	2	a
Private	23 Construction	61	380
Private	31-33 Manufacturing	16	344
Private	42 Wholesale trade	31	336
Private	44-45 Retail trade	128	1,374
Federal Government	48-49 Transportation and warehousing	6	38
Private	48-49 Transportation and warehousing	30	347
Local Government	51 Information	1	a
Private	51 Information	11	70
Private	52 Finance and insurance	37	313
Private	53 Real estate and rental and leasing	28	276
Private	54 Professional and technical services	53	a
Private	55 Management of companies and enterprises	1	a
Local Government	56 Administrative and waste services	1	a
Private	56 Administrative and waste services	35	301
State Government	61 Educational services	1	0
Local Government	61 Educational services	5	560
Private	61 Educational services	1	a

[3] http://www.bls.gov/cew/cewover.htm

Table 5 - Sample of QCEW Data, Beckham County, Oklahoma, 2006

Ownership Title	NAICS Description	Annual Average Establishment Count	Annual Average Employment
Private	62 Health care and social assistance	78	a
Local Government	71 Arts, entertainment, and recreation	1	a
Private	71 Arts, entertainment, and recreation	7	26
Private	72 Accommodation and food services	56	852
Private	81 Other services, except public administration	41	164
Federal Government	92 Public Administration	4	12
State Government	92 Public Administration	9	a
Local Government	92 Public Administration	18	233
Private	99 Unclassified	3	7

(a) Withheld to avoid disclosing data of individual companies; data are included in higher level totals

As shown in Table 5, not all of the QCEW data are released for public review. Some data are withheld to avoid disclosing data of individual companies. Thus, a methodology was developed to estimate the unknown employment numbers. The average number of employees per establishment type were developed for the state and used to fill in the gaps. Because the withheld data were included in the total employment count, estimated values were scaled up or down according to the ratio of the estimated total to the actual total.

Next, the employment counts for 2006 by NAICS and county were projected to 2060. The most recent available Oklahoma Employment Security Commission (OESC) 10-year projections of statewide employment by 2- and 3-digit NAICS were used to project demands to 2016. Specifically, the rate of change for each 2-digit NAICS level from the OESC state-level projections was applied to the BLS 2006 county employment to project employment by 2-digit NAICS to 2016 for each county. Beyond 2016 (to 2060), employment was assumed to grow in direct proportion to county population projections. That is, the ratio of 2-digit NAICS employment to county population remains constant after 2016.

When better information regarding the future employment of Oklahoma was available, it was used to adjust the employment projections. The only such information provided was from the Chickasaw Nation Report. The employment increases planned for both Love and Marshall Counties, as shown in Table 2.3 of the Chickasaw Report, were added to the employment growth for these counties to account for the future expansion.

Projections of total employment by county are shown in Table 6. Employment projections by 2-digit NAICS code for each county are presented in Appendix B. Statewide employment is estimated to increase by 31 percent from 2006 to 2060 as illustrated in Figure 4.

Table 6 - Projection of Total Employment for Oklahoma by County

County	2006	2010	2020	2030	2040	2050	2060
Adair	5,376	5,537	5,864	6,699	7,533	8,389	9,244
Alfalfa	1,237	1,286	1,359	1,359	1,359	1,382	1,405
Atoka	3,368	3,497	3,730	4,138	4,545	4,995	5,445
Beaver	1,425	1,484	1,579	1,605	1,631	1,658	1,684
Beckham	8,599	8,951	9,562	10,387	11,211	12,036	12,942

Table 6 - Projection of Total Employment for Oklahoma by County

County	2006	2010	2020	2030	2040	2050	2060
Blaine	3,094	3,228	3,453	3,756	4,058	4,361	4,688
Bryan	15,939	16,662	17,914	19,629	21,345	23,060	24,816
Caddo	6,988	7,286	7,766	8,008	8,250	8,492	8,710
Canadian	24,751	25,717	27,401	29,299	30,941	32,455	33,994
Carter	21,926	22,762	24,160	25,459	26,711	28,058	29,502
Cherokee	14,680	15,362	16,598	18,719	20,869	22,962	25,112
Choctaw	4,353	4,555	4,871	4,962	5,084	5,205	5,327
Cimarron	713	739	782	805	805	829	852
Cleveland	70,643	74,043	79,643	84,096	87,652	90,151	92,585
Coal	1,049	1,096	1,183	1,338	1,509	1,696	1,883
Comanche	40,220	41,929	44,742	46,946	48,659	50,006	51,107
Cotton	1,449	1,513	1,614	1,638	1,662	1,710	1,734
Craig	5,925	6,147	6,544	7,152	7,832	8,511	9,227
Creek	16,962	17,558	18,569	19,509	20,402	21,294	22,258
Custer	11,128	11,585	12,314	12,824	13,333	13,715	14,055
Delaware	7,900	8,276	8,954	10,084	11,250	12,506	13,816
Dewey	1,248	1,298	1,372	1,372	1,372	1,402	1,433
Ellis	1,007	1,050	1,109	1,109	1,079	1,079	1,109
Garfield	24,152	25,169	26,774	27,432	28,047	28,530	29,100
Garvin	9,007	9,334	9,844	10,019	10,193	10,403	10,612
Grady	12,885	13,352	14,145	14,956	15,687	16,417	17,174
Grant	1,105	1,148	1,217	1,241	1,241	1,288	1,311
Greer	1,492	1,557	1,655	1,655	1,683	1,711	1,739
Harmon	819	855	910	938	965	993	1,020
Harper	1,270	1,319	1,393	1,393	1,393	1,434	1,434
Haskell	3,714	3,895	4,216	4,740	5,291	5,842	6,449
Hughes	2,847	2,972	3,196	3,525	3,872	4,255	4,639
Jackson	10,886	11,293	11,972	12,535	12,985	13,361	13,661
Jefferson	1,249	1,299	1,377	1,398	1,418	1,459	1,501
Johnston	2,968	3,060	3,232	3,605	3,978	4,376	4,799
Kay	19,688	20,464	21,697	22,253	22,765	23,278	23,833
Kingfisher	5,908	6,090	6,431	7,108	7,785	8,462	9,215
Kiowa	2,429	2,540	2,706	2,733	2,760	2,815	2,870
Latimer	3,870	4,058	4,362	4,590	4,856	5,121	5,425
Le Flore	12,767	13,211	13,977	14,883	15,790	16,697	17,654
Lincoln	7,085	7,390	7,911	8,455	9,020	9,606	10,234
Logan	6,690	7,013	7,581	8,331	9,080	9,812	10,596
Love	3,370	3,531	9,875	10,484	11,129	11,809	12,490
Major	2,260	2,352	2,491	2,491	2,524	2,557	2,590
Marshall	4,308	4,426	7,490	8,930	10,406	11,954	13,575
Mayes	11,189	11,545	12,189	13,242	14,348	15,480	16,638
McClain	7,228	7,554	8,157	9,240	10,323	11,449	12,596
McCurtain	10,216	10,618	11,268	11,662	11,995	12,359	12,692
McIntosh	4,258	4,442	4,768	5,298	5,886	6,553	7,260
Murray	5,089	5,337	5,754	6,291	6,789	7,365	7,940
Muskogee	28,350	29,508	31,349	32,289	33,102	33,915	34,727
Noble	4,290	4,469	4,760	4,911	5,063	5,176	5,289
Nowata	1,788	1,852	1,974	2,219	2,464	2,723	2,997
Okfuskee	2,282	2,384	2,545	2,608	2,670	2,733	2,816
Oklahoma	420,127	438,854	469,036	488,298	502,840	513,427	523,887
Okmulgee	9,995	10,371	11,012	11,670	12,352	13,059	13,765
Osage	5,924	6,185	6,619	6,944	7,243	7,542	7,880
Ottawa	11,346	11,825	12,624	13,403	14,249	15,129	16,009
Pawnee	3,377	3,528	3,791	4,129	4,486	4,861	5,237
Payne	34,260	35,721	38,151	40,987	43,777	45,744	47,620

Table 6 - Projection of Total Employment for Oklahoma by County

County	2006	2010	2020	2030	2040	2050	2060
Pittsburg	16,912	17,570	18,643	19,351	20,177	21,121	22,144
Pontotoc	18,407	19,243	20,573	21,282	21,992	22,647	23,301
Pottawatomie	20,480	21,292	22,649	24,011	25,313	26,585	27,917
Pushmataha	3,127	3,266	3,513	3,895	4,301	4,755	5,209
Roger Mills	826	858	906	906	906	906	906
Rogers	23,822	24,667	26,219	28,695	30,996	33,356	35,774
Seminole	7,549	7,827	8,269	8,491	8,714	8,968	9,223
Sequoyah	9,156	9,577	10,306	11,247	12,167	13,108	14,048
Stephens	15,505	16,032	16,846	17,002	17,196	17,467	17,817
Texas	6,475	6,741	7,283	8,730	10,178	11,626	13,051
Tillman	2,173	2,259	2,393	2,444	2,495	2,546	2,622
Tulsa	341,500	355,930	379,487	395,775	407,255	415,969	424,444
Wagoner	6,804	7,057	7,512	8,163	8,763	9,352	9,972
Washington	19,510	20,352	21,659	21,872	22,170	22,469	22,810
Washita	2,287	2,380	2,528	2,589	2,630	2,692	2,733
Woods	3,110	3,242	3,439	3,477	3,514	3,552	3,626
Woodward	9,378	9,756	10,364	10,675	10,882	11,141	11,348
Statewide Total	**1,477,489**	**1,540,129**	**1,652,122**	**1,736,384**	**1,809,199**	**1,873,906**	**1,939,148**

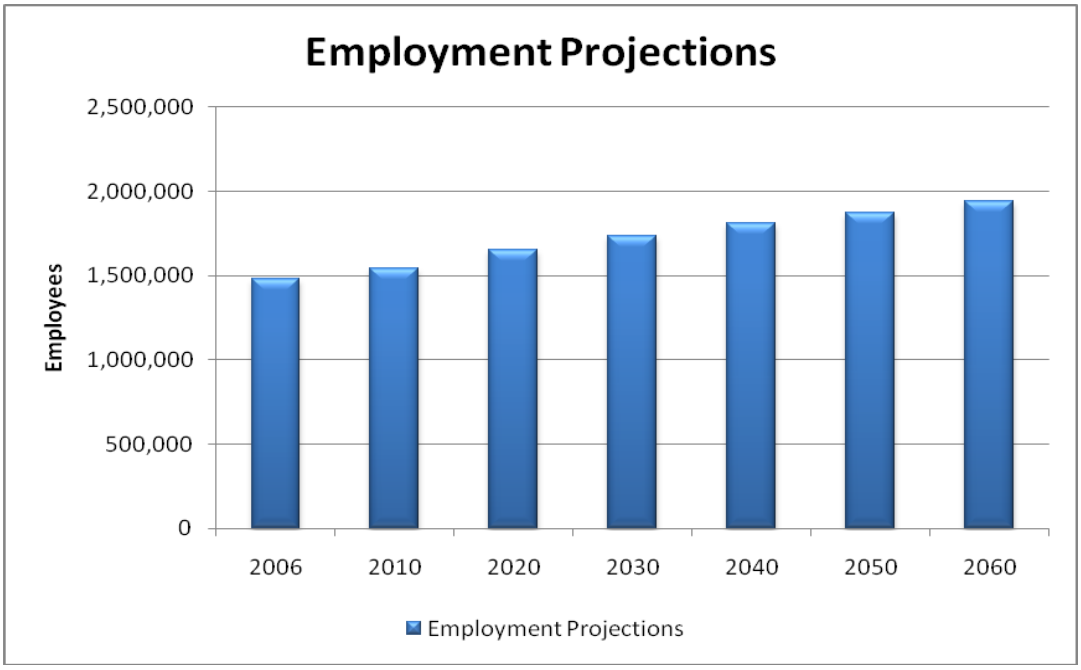

Figure 4 - Employment Projections

Water Use Coefficients

The per employee water use rates were developed from the IWR-MAIN Water Demand Management Software Nonresidential Database. IWR-MAIN is proprietary software developed by Camp Dresser & McKee Inc. (CDM) used in the development of water demand forecasts. The software is often used for planning by the U.S. Army Corps of Engineers (USACE). The nonresidential database contains average gallons of water use per employee per day (ged) at the 2-digit and 3-digit Standard Industrial Code (SIC). A

special tabulation was computed to transform the data to 2-digit NAICS code. The resulting water use factors are summarized by major employment groups in Table 7.

Table 7 - Nonresidential Water Use Coefficients from IWR-MAIN

NAICS	GED*
11 Agriculture, forestry, fishing and hunting	111.8
21 Mining, quarrying, and oil and gas extraction	488.4
22 Utilities	28.4
23 Construction	66.6
31-33 Manufacturing	144.5
42 Wholesale trade	44.1
44-45 Retail trade	46.4
48-49 Transportation and warehousing	57.2
51 Information	28.0
52 Finance and insurance	59.8
53 Real estate and rental and leasing	163.5
54 Professional and technical services	68.6
55 Management of companies and enterprises	64.0
56 Administrative and waste services	41.2
61 Educational services	103.6
62 Health care and social assistance	84.7
71 Arts, entertainment, and recreation	446.6
72 Accommodation and food services	185.5
81 Other services, except public administration	271.3
92 Public Administration	125.4
99 Unclassified	122.9

* GED-gallons per employee per day

The water use coefficients represent all water used at a given establishment on an average day divided by the number of employees. Establishments that generally only use water for sanitary use, such as retail trade shops and offices, have lower water use rates than establishments using water for additional services, such as for food preparation at schools or laundry washing at hotels.

Supplemental information for Pittsburg County was obtained and used to replace the standard employment water use factor for manufacturing through data collected from the McAlester Ammunition Plant[4].

3.3.3 Forecast

Results of the public-supplied nonresidential forecast including system losses for each county are shown in Table 8. Growth in county water demand is directly attributable to projected employment growth. Statewide water demands from the public supplied nonresidential sector are estimated to increase by 33 percent from 2007 to 2060 as illustrated in Figure 5.

[4] McAlester is included in the public supply nonresidential sector even though it is a self-supplied industrial establishment because McAlester provides water to rural water districts and experiences systems losses.

Table 8 – Public-Supply Nonresidential Water Demands Including System Losses (AFY)

County	2006	2010	2020	2030	2040	2050	2060
Adair	765	785	827	945	1,063	1,183	1,304
Alfalfa	160	167	176	176	176	179	182
Atoka	493	512	546	606	665	731	797
Beaver	293	305	324	329	335	340	346
Beckham	1,598	1,659	1,766	1,918	2,071	2,223	2,390
Blaine	453	473	506	551	595	639	688
Bryan	2,405	2,533	2,751	3,014	3,277	3,541	3,810
Caddo	876	916	981	1,011	1,042	1,072	1,100
Canadian	4,043	4,209	4,497	4,809	5,078	5,326	5,579
Carter	3,299	3,416	3,613	3,807	3,994	4,196	4,412
Cherokee	2,126	2,233	2,424	2,734	3,048	3,354	3,668
Choctaw	684	720	775	789	809	828	847
Cimarron	95	98	104	107	107	110	113
Cleveland	9,866	10,369	11,193	11,818	12,318	12,669	13,012
Coal	145	153	166	188	212	238	264
Comanche	5,313	5,545	5,926	6,218	6,445	6,623	6,769
Cotton	264	276	295	299	303	312	317
Craig	793	822	874	955	1,046	1,137	1,232
Creek	2,685	2,772	2,921	3,069	3,209	3,349	3,501
Custer	1,743	1,815	1,929	2,009	2,089	2,149	2,202
Delaware	1,208	1,273	1,389	1,564	1,745	1,940	2,143
Dewey	218	226	238	238	238	244	249
Ellis	151	158	167	167	163	163	167
Garfield	3,611	3,756	3,986	4,084	4,175	4,247	4,332
Garvin	1,646	1,702	1,791	1,822	1,854	1,892	1,930
Grady	1,986	2,055	2,172	2,297	2,409	2,521	2,638
Grant	168	175	185	188	188	196	199
Greer	187	195	208	208	212	215	219
Harmon	105	110	118	121	125	128	132
Harper	202	210	221	221	221	228	228
Haskell	595	621	669	753	840	928	1,024
Hughes	395	412	443	489	537	590	644
Jackson	1,545	1,605	1,704	1,784	1,848	1,902	1,945
Jefferson	167	173	183	186	189	194	200
Johnston	470	483	507	566	624	686	753
Kay	3,345	3,477	3,685	3,779	3,866	3,953	4,048
Kingfisher	1,219	1,255	1,324	1,463	1,603	1,742	1,897
Kiowa	408	426	454	459	463	472	481
Latimer	654	685	734	773	817	862	913
Le Flore	2,087	2,151	2,263	2,410	2,557	2,704	2,859
Lincoln	976	1,018	1,089	1,164	1,241	1,322	1,408
Logan	955	1,005	1,091	1,199	1,306	1,412	1,525
Love	548	576	2,648	2,811	2,984	3,166	3,349
Major	394	408	430	430	436	441	447
Marshall	679	698	1,715	2,044	2,382	2,737	3,108
Mayes	1,590	1,636	1,720	1,868	2,024	2,184	2,347
McClain	1,072	1,119	1,208	1,368	1,528	1,695	1,865
McCurtain	1,385	1,437	1,523	1,576	1,621	1,670	1,715
McIntosh	624	656	711	790	878	978	1,083
Murray	742	779	840	918	991	1,075	1,159
Muskogee	3,454	3,598	3,826	3,941	4,040	4,139	4,239
Noble	704	735	785	810	835	854	872
Nowata	242	250	266	299	333	368	405
Okfuskee	357	374	401	411	421	431	444
Oklahoma	59,203	61,862	66,147	68,863	70,914	72,407	73,882
Okmulgee	1,510	1,566	1,663	1,762	1,865	1,972	2,079

Table 8 – Public-Supply Nonresidential Water Demands Including System Losses (AFY)

County	2006	2010	2020	2030	2040	2050	2060
Osage	1,114	1,164	1,248	1,309	1,365	1,422	1,486
Ottawa	2,068	2,184	2,373	2,519	2,678	2,844	3,009
Pawnee	510	532	570	621	674	731	787
Payne	5,259	5,515	5,936	6,377	6,811	7,118	7,409
Pittsburg	3,088	3,162	3,288	3,412	3,558	3,725	3,905
Pontotoc	2,326	2,428	2,589	2,678	2,767	2,850	2,932
Pottawatomie	2,761	2,869	3,049	3,233	3,408	3,579	3,759
Pushmataha	405	424	457	507	560	619	678
Roger Mills	140	145	153	153	153	153	153
Rogers	3,503	3,630	3,862	4,227	4,566	4,914	5,270
Seminole	1,411	1,461	1,540	1,582	1,623	1,671	1,718
Sequoyah	1,325	1,393	1,509	1,647	1,782	1,919	2,057
Stephens	3,037	3,135	3,287	3,317	3,355	3,408	3,476
Texas	898	938	1,016	1,218	1,420	1,622	1,821
Tillman	309	322	343	350	357	364	375
Tulsa	43,051	44,846	47,779	49,830	51,275	52,372	53,439
Wagoner	987	1,023	1,088	1,182	1,269	1,354	1,444
Washington	4,136	4,300	4,556	4,600	4,663	4,726	4,798
Washita	391	406	430	440	447	458	465
Woods	433	452	480	485	490	496	506
Woodward	1,982	2,055	2,174	2,239	2,282	2,337	2,380
Statewide Total	**212,031**	**221,023**	**238,823**	**251,108**	**261,864**	**271,539**	**281,325**

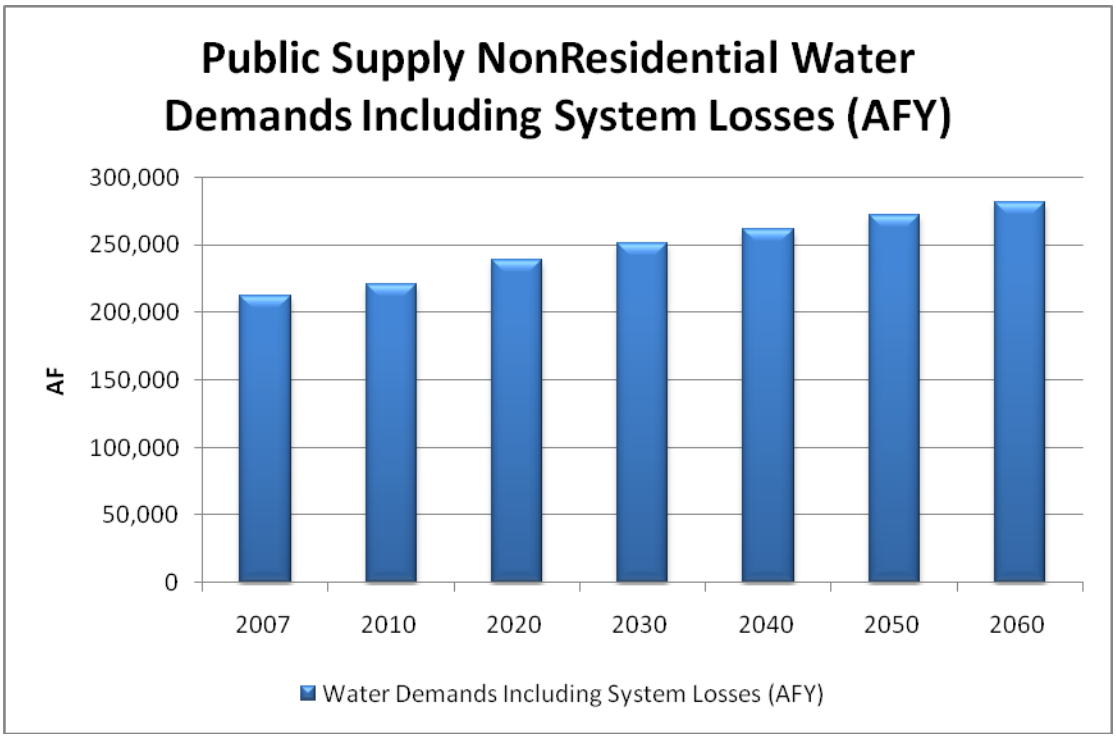

Figure 5 - Public Supply Nonresidential Water Demands Including System Losses (AFY)

3.4 Public-Supply M&I Summary

Table 9 provides a summary of the public-supplied M&I water demands by county that include residential demands, nonresidential demands, and system-losses.

Table 9 - Summary of Public-Supply M&I Demands Including System Losses (AFY)

COUNTY	2007	2010	2020	2030	2040	2050	2060
Adair	1,918	1,994	2,237	2,555	2,874	3,200	3,526
Alfalfa	873	873	882	882	882	897	912
Atoka	2,917	3,024	3,366	3,733	4,101	4,507	4,913
Beaver	698	714	740	752	765	777	789
Beckham	4,599	4,739	5,120	5,562	6,003	6,444	6,930
Blaine	2,416	2,474	2,683	2,918	3,153	3,388	3,642
Bryan	7,844	8,145	8,942	9,799	10,655	11,511	12,388
Caddo	3,242	3,305	3,470	3,578	3,686	3,794	3,892
Canadian	14,935	15,448	16,833	18,000	19,008	19,938	20,884
Carter	8,813	9,008	9,535	10,048	10,541	11,073	11,643
Cherokee	6,555	6,884	7,767	8,760	9,766	10,745	11,751
Choctaw	1,518	1,560	1,637	1,667	1,708	1,749	1,790
Cimarron	642	645	685	705	705	726	746
Cleveland	36,395	37,683	40,538	42,804	44,614	45,886	47,126
Coal	606	626	711	805	908	1,020	1,132
Comanche	15,177	16,682	17,839	18,717	19,400	19,937	20,376
Cotton	766	783	809	821	833	857	869
Craig	2,223	2,294	2,507	2,739	3,000	3,260	3,534
Creek	8,195	8,399	8,939	9,391	9,821	10,250	10,715
Custer	5,207	5,339	5,619	5,852	6,084	6,259	6,414
Delaware	4,027	4,223	4,781	5,384	6,007	6,678	7,377
Dewey	1,146	1,154	1,146	1,146	1,146	1,171	1,197
Ellis	738	736	730	730	711	711	730
Garfield	12,034	12,248	12,736	13,049	13,341	13,571	13,842
Garvin	4,690	4,760	4,926	5,014	5,101	5,206	5,311
Grady	5,050	5,188	5,531	5,848	6,133	6,419	6,715
Grant	710	716	737	752	752	780	794
Greer	1,028	1,037	1,049	1,049	1,067	1,085	1,103
Harmon	772	789	797	821	845	870	894
Harper	967	961	973	973	973	1,001	1,001
Haskell	1,270	1,324	1,466	1,648	1,840	2,032	2,243
Hughes	1,721	1,786	1,975	2,178	2,392	2,629	2,866
Jackson	4,505	4,619	4,899	5,129	5,314	5,467	5,590
Jefferson	769	776	795	807	819	843	866
Johnston	1,734	1,787	1,969	2,196	2,423	2,666	2,923
Kay	7,549	7,711	8,066	8,272	8,463	8,654	8,860
Kingfisher	2,839	2,928	3,193	3,529	3,865	4,202	4,575
Kiowa	1,233	1,247	1,274	1,287	1,300	1,326	1,351
Latimer	2,213	2,260	2,382	2,506	2,651	2,796	2,961
Le Flore	6,429	6,586	7,043	7,499	7,956	8,413	8,895
Lincoln	2,301	2,376	2,568	2,745	2,928	3,119	3,322
Logan	4,607	4,797	5,354	5,883	6,412	6,929	7,483
Love	1,447	1,524	5,138	5,455	5,790	6,144	6,498
Major	974	984	1,013	1,013	1,027	1,040	1,054
Marshall	2,133	2,257	3,634	4,333	5,049	5,800	6,586
Mayes	5,377	5,534	6,007	6,526	7,071	7,629	8,200
McClain	3,997	4,190	4,792	5,428	6,065	6,726	7,400
McCurtain	4,225	4,312	4,527	4,685	4,819	4,965	5,099
McIntosh	2,393	2,485	2,760	3,066	3,407	3,793	4,202
Murray	2,625	2,712	2,941	3,216	3,471	3,765	4,059

Table 9 - Summary of Public-Supply M&I Demands Including System Losses (AFY)

COUNTY	2007	2010	2020	2030	2040	2050	2060
Muskogee	9,937	10,130	10,580	10,898	11,172	11,446	11,720
Noble	1,617	1,662	1,759	1,815	1,871	1,913	1,955
Nowata	1,075	1,118	1,256	1,412	1,568	1,733	1,907
Okfuskee	1,385	1,408	1,461	1,497	1,533	1,569	1,616
Oklahoma	120,231	123,931	131,224	136,613	140,682	143,644	146,570
Okmulgee	10,686	10,930	11,716	12,415	13,141	13,893	14,645
Osage	7,708	7,895	8,460	8,876	9,258	9,640	10,073
Ottawa	5,017	5,179	5,575	5,918	6,292	6,681	7,069
Pawnee	2,274	2,350	2,588	2,818	3,062	3,318	3,574
Payne	12,193	12,688	13,656	14,671	15,670	16,374	17,045
Pittsburg	8,315	8,445	8,815	9,150	9,541	9,987	10,471
Pontotoc	5,931	6,074	6,376	6,596	6,816	7,019	7,222
Pottawatomie	5,890	6,060	6,460	6,848	7,220	7,583	7,963
Pushmataha	1,073	1,114	1,237	1,371	1,514	1,674	1,834
Roger Mills	613	618	626	626	626	626	626
Rogers	12,891	13,376	14,813	16,213	17,513	18,846	20,212
Seminole	2,742	2,801	2,923	3,002	3,081	3,171	3,261
Sequoyah	7,122	7,380	8,143	8,886	9,612	10,356	11,099
Stephens	8,472	8,570	8,785	8,866	8,967	9,109	9,291
Texas	3,576	3,819	4,599	5,513	6,427	7,342	8,242
Tillman	1,332	1,345	1,388	1,418	1,447	1,477	1,521
Tulsa	107,126	110,045	116,516	121,517	125,042	127,717	130,319
Wagoner	8,108	8,402	9,329	10,137	10,881	11,613	12,383
Washington	11,739	11,940	12,364	12,486	12,656	12,827	13,021
Washita	1,082	1,103	1,151	1,179	1,197	1,225	1,244
Woods	3,124	3,161	3,189	3,224	3,259	3,293	3,363
Woodward	5,599	5,718	5,989	6,169	6,288	6,438	6,558
Statewide Total	**583,901**	**601,891**	**647,038**	**682,391**	**713,982**	**743,158**	**772,773**

Section 4
Self-Supplied, Non-Agricultural Demands

The self-supplied sector represents establishments that obtain their water from privately owned sources, such as wells or surface diversions. This sector includes water use from self-supplied households, pulp mills, refineries, meat packing plants, thermoelectric power plants, and activities from oil and gas exploration and drilling, for example. While agriculture demands are often self-supplied, these demands are treated separately and are discussed in Section 5. Water demand sectors discussed here include self-supplied residential, oil and gas, thermoelectric power, and self-supplied large industries.

4.1 Self-Supplied Residential

The self-supplied residential sector captures water use from households not connected to a public water supply system. It is assumed that these households are located in rural areas of the state. While it may be true that some self-supplied residential homes use well water for livestock care, the demands for the self-supplied residential sector only represent water use inside the home and outside for gardening, car washing, domestic animal care, recreation, etc. Livestock demands are captured in the agriculture demands.

The basic methodology employed to estimate future water demands for the self-supplied residential sector is:

$$Q_{c,y}^{SSR} = \left[rgpcd_c \times P_{c,y}^{SSR} \right]$$ *Equation 3*

Where:

- $Q_{c,y}^{SSR}$ = Self-supplied residential water demand in county (c) in year (y) in acre-feet per year (AFY)
- $rgpcd_c$ = Weighted average residential per capita daily water use in county (c) from Provider Survey
- $P_{c,y}^{SSR}$ = Population self-supplied in county (c) in year (y)

The data used to develop the self-supplied residential forecast are similar to the data used in the public supply residential forecast, as discussed in Section 3.2.2. Population projections serve as a basis for the forecast. The population projections were allocated among public-supplied and self-supplied households using 2005 USGS estimates.

The USGS preliminary numbers were used to divide county population projections into public-supplied and self-supplied for 2007. The ratio of public-supplied to self-supplied for each county is assumed to remain constant into the future. The self-supplied population projections are shown in Table 10. As shown, some counties have no self-supplied households. Given the assumptions, the statewide population of self-supplied households is expected to increase almost 41 percent from 2007 to 2060, but remains less than a half million in 2060.

Table 10 - Self-Supplied Population Projections by County

County	2007	2010	2020	2030	2040	2050	2060
Adair	9,140	9,582	11,173	12,763	14,354	15,983	17,613
Alfalfa	860	851	851	851	851	866	880
Atoka	3,030	3,139	3,524	3,909	4,294	4,719	5,145
Beaver	2,620	2,647	2,692	2,737	2,782	2,826	2,871
Beckham	1,980	2,032	2,213	2,403	2,594	2,785	2,995
Blaine	1,130	1,152	1,253	1,362	1,472	1,582	1,700
Bryan	2,780	2,869	3,165	3,468	3,771	4,074	4,384
Caddo	11,730	11,845	12,345	12,730	13,115	13,499	13,845
Canadian	0	0	0	0	0	0	0
Carter	220	223	236	249	261	274	289
Cherokee	7,430	7,802	8,962	10,108	11,269	12,399	13,560
Choctaw	4,700	4,736	4,858	4,949	5,070	5,192	5,313
Cimarron	1,120	1,120	1,190	1,225	1,225	1,260	1,295
Cleveland	12,670	13,045	14,015	14,799	15,425	15,864	16,293
Coal	1,570	1,614	1,859	2,103	2,372	2,666	2,959
Comanche	2,190	2,236	2,388	2,518	2,619	2,699	2,764
Cotton	0	0	0	0	0	0	0
Craig	800	824	914	999	1,094	1,189	1,288
Creek	7,050	7,200	7,700	8,090	8,460	8,830	9,230
Custer	3,320	3,379	3,537	3,683	3,830	3,940	4,037
Delaware	11,500	12,032	13,834	15,581	17,383	19,324	21,348
Dewey	1,070	1,070	1,047	1,047	1,047	1,070	1,093
Ellis	1,380	1,359	1,323	1,323	1,287	1,287	1,323
Garfield	1,460	1,472	1,517	1,554	1,589	1,616	1,648
Garvin	4,150	4,168	4,274	4,350	4,426	4,517	4,608
Grady	15,740	16,096	17,251	18,240	19,131	20,021	20,945
Grant	650	650	663	675	675	701	714
Greer	0	0	0	0	0	0	0
Harmon	0	0	0	0	0	0	0
Harper	960	943	943	943	943	971	971
Haskell	5,280	5,500	6,233	7,007	7,822	8,637	9,533
Hughes	940	973	1,085	1,197	1,315	1,445	1,575
Jackson	1,080	1,100	1,165	1,220	1,264	1,301	1,330
Jefferson	140	140	142	144	146	151	155
Johnston	110	114	127	142	157	172	189
Kay	2,240	2,257	2,335	2,394	2,450	2,505	2,564
Kingfisher	4,010	4,140	4,627	5,114	5,601	6,088	6,629
Kiowa	0	0	0	0	0	0	0
Latimer	1,320	1,335	1,395	1,468	1,553	1,638	1,735
Le Flore	6,360	6,496	7,001	7,455	7,909	8,363	8,842
Lincoln	17,650	18,088	19,704	21,059	22,466	23,926	25,490
Logan	11,260	11,695	13,146	14,445	15,745	17,014	18,374
Love	310	327	901	954	1,010	1,069	1,129
Major	2,090	2,073	2,101	2,101	2,129	2,157	2,185
Marshall	650	697	858	1,023	1,192	1,369	1,555
Mayes	0	0	0	0	0	0	0
McClain	7,430	7,800	9,104	10,313	11,522	12,778	14,059
McCurtain	7,490	7,579	7,920	8,197	8,431	8,687	8,921
McIntosh	0	0	0	0	0	0	0
Murray	0	0	0	0	0	0	0
Muskogee	6,850	6,903	7,136	7,350	7,535	7,720	7,905
Noble	1,520	1,543	1,620	1,672	1,723	1,762	1,800
Nowata	690	719	821	922	1,024	1,132	1,246
Okfuskee	1,100	1,106	1,133	1,161	1,189	1,217	1,254
Oklahoma	14,040	14,279	14,972	15,586	16,051	16,389	16,722

Table 10 - Self-Supplied Population Projections by County

County	2007	2010	2020	2030	2040	2050	2060
Okmulgee	0	0	0	0	0	0	0
Osage	6,760	6,899	7,393	7,756	8,091	8,425	8,802
Ottawa	6,990	7,100	7,588	8,056	8,565	9,094	9,622
Pawnee	4,650	4,792	5,319	5,793	6,293	6,820	7,346
Payne	7,920	8,193	8,816	9,472	10,117	10,571	11,005
Pittsburg	0	0	0	0	0	0	0
Pontotoc	5,490	5,554	5,768	5,967	6,166	6,350	6,534
Pottawatomie	20,830	21,249	22,706	24,072	25,377	26,652	27,988
Pushmataha	1,540	1,591	1,800	1,995	2,203	2,436	2,669
Roger Mills	680	680	680	680	680	680	680
Rogers	5,580	5,793	6,509	7,123	7,695	8,280	8,881
Seminole	3,980	4,009	4,136	4,247	4,359	4,486	4,613
Sequoyah	820	847	938	1,024	1,108	1,193	1,279
Stephens	6,620	6,620	6,697	6,759	6,836	6,944	7,083
Texas	2,600	2,798	3,479	4,170	4,862	5,553	6,234
Tillman	670	670	685	699	714	728	750
Tulsa	8,940	9,097	9,590	10,002	10,292	10,512	10,727
Wagoner	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0
Washita	2,200	2,222	2,297	2,353	2,390	2,447	2,484
Woods	1,110	1,117	1,117	1,129	1,142	1,154	1,178
Woodward	3,500	3,544	3,692	3,803	3,877	3,969	4,043
Statewide Total	**294,690**	**301,725**	**326,721**	**348,946**	**370,595**	**392,224**	**414,477**

Population projections are used as the driver of the self-supplied residential forecast. The average daily use of the self-supplied households is assumed to be similar to publically-supplied households in a given county. Thus, the rgpcd developed from the Provider Survey is used as the per unit use for the self-supplied residential sector.

4.1.1 Forecast

Results of the self-supplied residential forecast are shown in Table 11 for each county. Growth in county water demand is directly attributable to projected growth in self-supplied population. Figure 6 shows statewide water demands from the self-supplied residential sector, which are estimated to increase by 39 percent from 2007 to 2060.

Table 11 - Self-Supplied Residential Water Demands (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Adair	702	736	858	980	1,102	1,227	1,353
Alfalfa	117	115	115	115	115	117	119
Atoka	544	563	632	702	771	847	923
Beaver	346	350	355	361	367	373	379
Beckham	313	321	349	380	410	440	473
Blaine	186	189	206	224	242	260	280
Bryan	357	369	407	446	485	524	564
Caddo	1,422	1,436	1,496	1,543	1,589	1,636	1,678
Canadian	-	-	-	-	-	-	-
Carter	22	22	24	25	26	28	29
Cherokee	755	793	911	1,028	1,146	1,260	1,378
Choctaw	324	326	335	341	349	358	366
Cimarron	337	337	358	369	369	379	390
Cleveland	1,291	1,329	1,428	1,508	1,571	1,616	1,660

Table 11 - Self-Supplied Residential Water Demands (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Coal	148	153	176	199	224	252	280
Comanche	171	175	187	197	205	211	216
Cotton	-	-	-	-	-	-	-
Craig	68	70	77	84	92	100	109
Creek	532	544	581	611	639	667	697
Custer	440	447	468	488	507	522	535
Delaware	954	998	1,147	1,292	1,441	1,602	1,770
Dewey	263	263	257	257	257	263	269
Ellis	272	268	261	261	254	254	261
Garfield	186	188	193	198	202	206	210
Garvin	467	469	481	490	498	508	519
Grady	1,176	1,202	1,288	1,362	1,429	1,495	1,564
Grant	78	78	80	81	81	84	86
Greer	-	-	-	-	-	-	-
Harmon	-	-	-	-	-	-	-
Harper	272	267	267	267	267	275	275
Haskell	447	465	528	593	662	731	807
Hughes	83	86	96	106	116	128	139
Jackson	110	112	119	124	129	133	135
Jefferson	12	12	12	12	12	13	13
Johnston	11	12	13	15	16	18	20
Kay	184	186	192	197	202	206	211
Kingfisher	536	553	618	683	748	813	885
Kiowa	-	-	-	-	-	-	-
Latimer	190	192	201	212	224	236	250
Le Flore	541	553	596	635	673	712	753
Lincoln	1,360	1,393	1,518	1,622	1,731	1,843	1,964
Logan	1,388	1,442	1,621	1,781	1,941	2,097	2,265
Love	27	28	78	83	88	93	98
Major	208	206	209	209	212	215	217
Marshall	57	61	75	89	104	119	136
Mayes	-	-	-	-	-	-	-
McClain	757	794	927	1,050	1,173	1,301	1,432
McCurtain	694	703	734	760	782	805	827
McIntosh	-	-	-	-	-	-	-
Murray	-	-	-	-	-	-	-
Muskogee	658	663	686	706	724	742	759
Noble	126	128	134	138	143	146	149
Nowata	49	51	58	65	72	80	88
Okfuskee	95	95	98	100	102	105	108
Oklahoma	1,079	1,098	1,151	1,198	1,234	1,260	1,286
Okmulgee	-	-	-	-	-	-	-
Osage	978	998	1,069	1,122	1,170	1,218	1,273
Ottawa	688	698	746	792	842	895	947
Pawnee	591	609	676	736	800	867	934
Payne	648	671	722	775	828	865	901
Pittsburg	-	-	-	-	-	-	-
Pontotoc	565	572	594	615	635	654	673
Pottawatomie	1,253	1,279	1,366	1,449	1,527	1,604	1,684
Pushmataha	86	89	101	112	123	136	149
Roger Mills	104	104	104	104	104	104	104
Rogers	579	601	675	739	798	859	922
Seminole	223	225	232	238	244	251	258
Sequoyah	100	104	115	126	136	146	157
Stephens	833	833	843	851	860	874	892

Table 11 - Self-Supplied Residential Water Demands (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Texas	339	365	454	545	635	725	814
Tillman	80	80	81	83	85	87	89
Tulsa	903	919	969	1,010	1,040	1,062	1,084
Wagoner	-	-	-	-	-	-	-
Washington	-	-	-	-	-	-	-
Washita	142	144	148	152	154	158	161
Woods	352	355	355	358	362	366	374
Woodward	723	732	763	786	801	820	835
Statewide Total	**29,543**	**30,236**	**32,636**	**34,799**	**36,897**	**39,013**	**41,193**

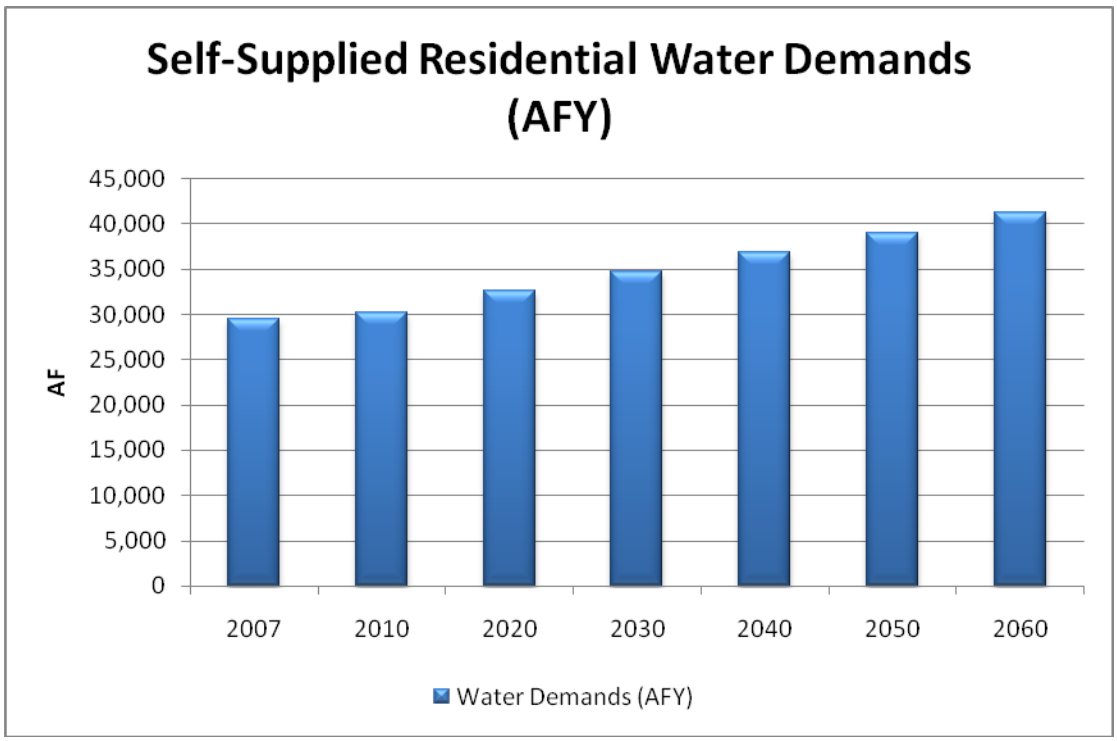

Figure 6 - Self-Supplied Residential Water Demands (AFY)

4.2 Oil and Gas

The oil and gas industry is a major contributor to the economic structure in Oklahoma. One in seven jobs in Oklahoma is directly or indirectly supported by the oil and natural gas industry[5]. Water availability is key to oil and gas drilling and exploration activities thus water use by this important sector is estimated for the OCWP.

Water is used in association with many oil and gas activities, including use as a supplemental fluid in enhanced recovery of petroleum resources; during drilling and

[5] Oklahoma Corporation Commission, *2007 Report on Crude Oil and Natural Gas Activity within the State of Oklahoma*, August 2008.

completion of an oil or gas well; during workover of an oil or gas well; as rig wash water; as coolant for internal combustion engines for rigs, compressors, and other equipment; and for sanitary purposes. Unconventional drilling techniques require more water use per completion than conventional drilling techniques. Oil from shale deposits are often drilled using unconventional techniques and require even more water to penetrate through the shale deposits.

There are challenges in estimating both current and future water demands from the oil and gas industry. While Oklahoma law requires that oil and gas companies apply for a 90-day provisional temporary (PT) water use permit for oil and gas drilling activities, water amounts requested on the PT permit is not necessarily representative of actual use. Future trends in the oil and gas industry rely on many factors, such as economy, price, and technology. Future trends, if anything, are uncertain. Thus, the forecast for the oil and gas sector makes use of the best available data for both the present and future. Estimated water use per drilling activity has been increased to a level considered adequate to cover uncertainties related to future developments in technology and other contingencies that may require more water per activity.

4.2.1 Methodology

Given the statewide variance in recent drilling activities, water demands for the oil and gas industry are estimated by drilling type, or sub-sector: conventional, horizontal, and Woodford Shale. The basic methodology for estimating demands by drilling category is number of drilling activities times water used per activity in AF, as shown in Equation 4. Sub-sector demands are then summed to estimate total demands from all oil and gas activities.

$$Q^{O\&G}_{s,c,y} = [DA_{s,c,y} \times WU_{s,c,y}]$$ *Equation 4*

Where:

- $Q^{O\&G}_{s,c,y}$= Oil and gas drilling water demand for sub-sector (s) in county (c) in year (y) in AFY
- $DA_{s,c,y}$ = Number of estimated drilling activities for sub-sector (s) in county (c) in year (y)
- $WU_{s,c,y}$ = Water use per drilling activity for sub-sector (s) in county (c) and in year (y) in AF

Two key pieces of information were developed for the oil and gas forecast by sub-sector: drilling activity and water use per activity.

4.2.2 Future Drilling Activity

For each sub-sector, an estimate of drilling activity in the future was developed using data collected from the Oklahoma Corporation Commission (OCC) website. Oil and gas drilling

data were collected from 1983 through 2008 for the entire State of Oklahoma by county. The data include oil, gas, dry and total wells, footage, average depth, and success ratio.

Additionally, conventional drilling data for Osage County, Oklahoma were provided by Oklahoma Independent Petroleum Association (OIPA) and Mid-Continent Oil and Gas Association from 1989–2003. These data were originally collected via permitting information by the Bureau of Indian Affairs (BIA). The data were used to replace the original OCC data because the BIA has well permitting authority in Osage County.

The OCC and BIA data were identified as conventional, horizontal, or Woodford Shale drilling and each dataset was stored in a separate database. Data from the following counties were considered to be Woodford Shale drilling—Atoka, Canadian, Carter, Coal, Hughes, Marshall, and Pittsburg. Because the Woodford Shale is a recent play, analysis was conducted on data for these counties from 2001–2008.

Linear regression analysis was conducted on the sum of statewide drilling data (by sub-sector) to estimate a trend in future drilling activities. For conventional drilling, statewide data were analyzed using linear regression from 1989–2008. Prior years were excluded to avoid a negative slope in the regression line. For horizontal and Woodford Shale drilling, data were analyzed using linear regressions from 2001–2008, as there was very little non-conventional drilling prior to 2001.

Results of the regression analysis were used to estimate statewide conventional drilling activities in 5 year increments to 2060. In order to develop a forecast representative of reasonable maximum future drilling activities, the standard error from the regression analysis was added to the model. This addition serves to address potential real-world variability associated with this industry. The statewide estimate of future conventional drilling activity was then allocated to counties based on the ratio of average county activity to statewide average activity during the historical dataset (1989–2008). This process was replicated to estimate future horizontal drilling activities statewide and for counties (county to state ratios were developed based on 2001–2008 dataset).

Slight but necessary alterations were made to the methodology for estimating Woodford Shale drilling activities in future years. Linear regression was conducted to estimate a trend line for future activity. Standard error was added to the resulting regression model to account for uncertainty. The regression model was used to estimate statewide totals for Woodford Shale drilling activity to 2020. Close coordination with industry leaders reveals that while Woodford Shale activity is expected to increase over the next decade, it is likely that drilling resources within the Woodford Shale will be exhausted following an estimated peak in activity near 2020. Thus, 2030 demands are assumed to decline to 2010 conditions and then decline to nearly zero from 2030 to 2060. Linear interpolation was used to estimate drilling from 2035 to 2060. The statewide estimate of future Woodford Shale drilling activity was allocated to counties based on the ratio of average county activity to total average activity during the historical dataset (2001–2008).

Estimates of future drilling activity by drilling type are provided in Table 12. Conventional and horizontal drilling is estimated to be 74 and 26 percent of 2060 drilling, respectively. Woodford Shale drilling peaks at about 1,600 activities in 2020.

Table 12 - Estimate of Future Drilling Activity by Drilling Type

County	Type	2008	2010	2020	2030	2040	2050	2060
Adair	*No drilling activity*							
Alfalfa	Conventional	23	31	35	40	45	50	54
	Horizontal	5	7	12	18	24	29	35
Atoka	Woodford Shale	19	27	43	27	18	9	0
Beaver	Conventional	114	153	177	201	225	248	272
	Horizontal	1	2	3	4	6	7	9
Beckham	Conventional	57	77	89	101	113	125	136
	Horizontal	1	2	3	4	6	7	9
Blaine	Conventional	50	67	77	88	98	108	119
	Horizontal	0	0	0	0	0	0	0
Bryan	Conventional	4	5	6	7	8	9	10
	Horizontal	0	0	0	0	0	0	0
Caddo	Conventional	64	86	100	113	127	140	153
	Horizontal	1	2	3	4	6	7	9
Canadian	Woodford Shale	112	156	255	156	105	53	2
Carter	Woodford Shale	111	156	253	156	104	53	2
Cherokee	Conventional	0	0	0	0	0	0	0
	Horizontal	0	0	0	0	0	0	0
Choctaw	*No drilling activity*							
Cimarron	Conventional	11	15	17	19	22	24	26
	Horizontal	0	0	0	0	0	0	0
Cleveland	Conventional	9	12	14	16	18	20	22
	Horizontal	1	2	3	4	6	7	9
Coal	Woodford Shale	55	76	124	76	51	26	1
Comanche	Conventional	9	12	14	16	18	19	21
	Horizontal	0	0	0	0	0	0	0
Cotton	Conventional	2	2	3	3	3	4	4
	Horizontal	0	0	0	0	0	0	0
Craig	Conventional	5	7	8	9	10	11	12
	Horizontal	0	0	0	0	0	0	0
Creek	Conventional	36	49	56	64	72	79	87
	Horizontal	0	0	0	0	0	0	0
Custer	Conventional	57	77	89	100	112	124	136
	Horizontal	2	3	6	9	12	15	17
Delaware	*No drilling activity*							
Dewey	Conventional	43	59	68	77	86	95	104
	Horizontal	2	3	5	7	9	11	13
Ellis	Conventional	50	68	78	89	99	110	120
	Horizontal	26	39	70	102	134	166	198
Garfield	Conventional	29	39	45	51	57	63	69
	Horizontal	1	2	3	4	6	7	9
Garvin	Conventional	81	109	126	143	160	177	194
	Horizontal	1	2	3	4	6	7	9
Grady	Conventional	94	127	147	166	186	206	225
	Horizontal	2	3	6	9	12	15	17
Grant	Conventional	27	36	42	47	53	58	64
	Horizontal	3	4	8	11	15	18	22
Greer	Conventional	1	1	1	2	2	2	2
	Horizontal	0	0	0	0	0	0	0

Table 12 - Estimate of Future Drilling Activity by Drilling Type

County	Type	2008	2010	2020	2030	2040	2050	2060
Harmon	Conventional	0	1	1	1	1	1	1
	Horizontal	0	0	0	0	0	0	0
Harper	Conventional	49	67	77	87	97	108	118
	Horizontal	3	5	9	13	18	22	26
Haskell	Conventional	50	67	78	88	99	109	119
	Horizontal	43	64	116	169	221	274	326
Hughes	Woodford Shale	108	151	245	151	101	51	2
Jackson	Conventional	1	2	2	3	3	3	3
	Horizontal	1	2	3	4	6	7	9
Jefferson	Conventional	6	8	10	11	12	13	15
	Horizontal	0	0	0	0	0	0	0
Johnston	Conventional	0	0	1	1	1	1	1
	Horizontal	5	8	14	20	26	33	39
Kay	Conventional	27	36	42	48	53	59	65
	Horizontal	0	0	0	0	0	0	0
Kingfisher	Conventional	33	44	51	58	65	72	79
	Horizontal	1	2	3	4	6	7	9
Kiowa	Conventional	7	9	10	12	13	14	16
	Horizontal	0	0	0	0	0	0	0
Latimer	Conventional	77	105	121	137	153	169	186
	Horizontal	3	5	9	13	17	21	25
Le Flore	Conventional	42	57	66	75	83	92	101
	Horizontal	39	58	107	155	203	251	299
Lincoln	Conventional	41	56	64	73	82	90	99
	Horizontal	13	20	36	53	69	86	102
Logan	Conventional	39	53	61	70	78	86	94
	Horizontal	9	13	24	35	45	56	67
Love	Conventional	7	10	11	13	14	16	17
	Horizontal	0	0	0	0	0	0	0
Major	Conventional	103	139	161	182	204	225	247
	Horizontal	1	2	3	4	6	7	9
Marshall	Woodford Shale	15	21	33	21	14	7	0
Mayes	Conventional	4	6	7	7	8	9	10
	Horizontal	0	0	0	0	0	0	0
McClain	Conventional	27	37	42	48	54	60	65
	Horizontal	1	2	3	4	6	7	9
McCurtain	Conventional	0	0	0	0	0	0	0
	Horizontal	0	0	0	0	0	0	0
McIntosh	Conventional	30	40	47	53	59	66	72
	Horizontal	24	35	64	93	122	150	179
Murray	Conventional	6	8	9	11	12	13	14
	Horizontal	0	0	0	0	0	0	0
Muskogee	Conventional	7	9	10	12	13	15	16
	Horizontal	2	3	6	9	12	15	17
Noble	Conventional	60	81	93	106	118	130	143
	Horizontal	2	2	4	6	8	10	12
Nowata	Conventional	67	90	104	118	132	145	159
	Horizontal	0	0	0	0	0	0	0
Okfuskee	Conventional	31	41	48	54	61	67	73
	Horizontal	4	6	10	15	20	24	29
Oklahoma	Conventional	39	52	61	69	77	85	93
	Horizontal	3	4	7	10	14	17	20
Okmulgee	Conventional	29	39	45	51	57	63	69

Table 12 - Estimate of Future Drilling Activity by Drilling Type

County	Type	2008	2010	2020	2030	2040	2050	2060
	Horizontal	1	2	3	4	6	7	9
Osage	Conventional	87	117	135	153	171	190	208
	Horizontal	0	0	0	0	0	0	0
Ottawa	*No drilling activity*							
Pawnee	Conventional	8	11	13	15	16	18	20
	Horizontal	1	2	3	4	6	7	9
Payne	Conventional	30	41	48	54	60	67	73
	Horizontal	3	5	8	12	16	20	24
Pittsburg	Woodford Shale	287	401	652	401	269	136	4
Pontotoc	Conventional	28	37	43	49	55	61	67
	Horizontal	1	2	3	4	6	7	9
Pottawatomie	Conventional	23	31	36	40	45	50	55
	Horizontal	10	15	27	40	52	64	77
Pushmataha	Conventional	2	3	4	4	5	5	6
	Horizontal	0	0	0	0	0	0	0
Roger Mills	Conventional	114	154	178	201	225	249	273
	Horizontal	5	7	12	18	24	29	35
Rogers	Conventional	18	25	29	32	36	40	44
	Horizontal	3	4	7	10	14	17	20
Seminole	Conventional	45	61	71	80	90	99	109
	Horizontal	9	14	25	36	47	58	69
Sequoyah	Conventional	10	13	15	17	19	21	23
	Horizontal	0	0	0	0	0	0	0
Stephens	Conventional	110	148	171	194	217	240	263
	Horizontal	3	4	8	11	15	18	22
Texas	Conventional	119	160	185	210	234	259	284
	Horizontal	9	13	24	35	46	57	68
Tillman	Conventional	3	4	5	6	7	7	8
	Horizontal	1	2	3	4	6	7	9
Tulsa	Conventional	15	21	24	27	30	33	37
	Horizontal	2	3	6	8	11	13	16
Wagoner	Conventional	13	17	20	23	25	28	31
	Horizontal	2	3	6	9	12	15	17
Washington	Conventional	57	77	89	101	113	124	136
	Horizontal	0	0	0	0	0	0	0
Washita	Conventional	45	61	70	80	89	99	108
	Horizontal	22	33	60	87	115	142	169
Woods	Conventional	82	111	128	145	162	179	196
	Horizontal	1	2	3	4	6	7	9
Woodward	Conventional	102	138	159	181	202	223	245
	Horizontal	0	0	0	0	0	0	0
Statewide Total	**Conventional**	**2,459**	**3,320**	**3,834**	**4,349**	**4,863**	**5,378**	**5,892**
	Horizontal	**274**	**408**	**745**	**1,081**	**1,417**	**1,754**	**2,090**
	Woodford Shale	**706**	**987**	**1,606**	**987**	**661**	**336**	**10**

4.2.3 Future Water Use per Activity

Estimates of water use per drilling activity by sub-sector were developed based on input from industry leaders at OIPA and Mid-Continent Oil and Gas Association. Water use per activity captures water used for drilling and cementing as well as completion. Unique values are estimated for each county by sub-sector based on average well depth, i.e., deeper wells are assumed to require more water for drilling. Table 13 provides a summary

of estimated current water use per drilled well for conventional, horizontal, and Woodford Shale drilling.

Table 13 – Estimates of Current Water Use per Well (in Barrels)

Operation		Conventional	Horizontal	Woodford Shale
Drilling & Cementing	≤ 12,000 feet	8,000	12,000 (incl. horizontal and vertical sections)	8,000
	>12,000 feet	21,000	23,000 (incl. horizontal and vertical sections)	21,000
Completion		25,000	78,000	150,000

Unconventional drilling techniques require more water use per well. Hydraulic fracturing ("fracing") is reported to require substantially more water per well. This technique is common in the Woodford Shale region of the state, resulting in higher water use factors and therefore higher water demand for drilling activities in these counties. Based on the above table, water use for conventional drilling ranges from 4.3–5.9 AF per well, horizontal drilling ranges from 12–13 AF per well, and drilling in the Woodford Shale region ranges from 20–22 AF per well.

To account for uncertainty in future water use per drilled well, an increasing trend is applied to the water use per well from 2010 to 2060. This is based on the assumption that the accessibility of remaining oil and gas deposits in the future will decline. For conventional and Woodford Shale drilling, water use factors are multiplied by a factor of 2 in 2060, moving linearly from current values to the 2060 value. For horizontal drilling, water use factors are multiplied by a factor of 2.5 in 2060, moving linearly from current values to the 2060 value.

4.2.4 Forecast

Results of the oil and gas forecast are provided in Table 14 for each county. Figure 7 shows the increase in statewide oil demand from 2008-2060. In the base year, water demands from the oil and gas industry are estimated at 29,107 AF, representing 1.6 percent of the total water used in Oklahoma. Under the conditions outlined herein, statewide demands are estimated to reach 115,570 AF by 2060, or 4.8 percent of total demands from all sectors.

Table 14 – Estimated Demand from Oil and Gas Activities by Drilling Type (AFY)

County	Drilling Type	Estimated Water Demand (AFY)						
		2008	2010	2020	2030	2040	2050	2060
Adair	*No drilling activity*							
Alfalfa	Conventional	96	135	185	242	308	381	462
	Horizontal	53	83	193	340	525	747	1,006
Atoka	Woodford Shale	420	610	1,177	836	636	361	12
Beaver	Conventional	483	677	927	1,215	1,543	1,909	2,314
	Horizontal	13	21	48	85	131	187	252
Beckham	Conventional	338	473	648	850	1,079	1,335	1,618
	Horizontal	15	23	54	95	147	210	282
Blaine	Conventional	211	296	405	531	674	834	1,011
	Horizontal							

Table 14 – Estimated Demand from Oil and Gas Activities by Drilling Type (AFY)

County	Drilling Type	Estimated Water Demand (AFY)						
		2008	2010	2020	2030	2040	2050	2060
Bryan	Conventional	17	24	33	43	54	67	82
	Horizontal							
Caddo	Conventional	380	532	729	956	1,213	1,501	1,820
	Horizontal	15	23	54	95	147	210	282
Canadian	Woodford Shale	2,466	3,581	6,905	4,908	3,733	2,120	70
Carter	Woodford Shale	2,266	3,291	6,344	4,509	3,430	1,948	64
Cherokee	Conventional	1	1	1	1	2	2	3
	Horizontal							
Choctaw	Conventional	0	0	0	0	0	0	0
	Horizontal							
Cimarron	Conventional	47	65	90	117	149	185	224
	Horizontal							
Cleveland	Conventional	39	54	74	97	124	153	185
	Horizontal	13	21	48	85	131	187	252
Coal	Woodford Shale	1,206	1,750	3,375	2,399	1,825	1,036	34
Comanche	Conventional	38	53	73	95	121	150	181
	Horizontal							
Cotton	Conventional	7	10	14	18	23	28	34
	Horizontal							
Craig	Conventional	21	30	41	54	68	84	102
	Horizontal							
Creek	Conventional	154	216	295	387	492	608	737
	Horizontal							
Custer	Conventional	337	472	647	848	1,076	1,332	1,615
	Horizontal	30	47	108	191	295	419	565
Delaware	*No drilling activity*							
Dewey	Conventional	185	259	355	465	590	731	886
	Horizontal	20	31	72	128	197	280	377
Ellis	Conventional	214	300	410	538	683	845	1,025
	Horizontal	301	474	1,101	1,940	2,992	4,257	5,736
Garfield	Conventional	122	172	235	308	391	484	586
	Horizontal	13	21	48	85	131	187	252
Garvin	Conventional	345	483	662	868	1,101	1,363	1,652
	Horizontal	13	21	48	85	131	187	252
Grady	Conventional	558	782	1,070	1,403	1,781	2,204	2,672
	Horizontal	30	47	108	191	295	419	565
Grant	Conventional	113	159	217	285	362	448	543
	Horizontal	33	52	121	213	328	467	629
Greer	Conventional	4	6	8	10	13	16	19
	Horizontal							
Harmon	Conventional	2	3	4	5	6	8	9
	Horizontal							
Harper	Conventional	210	294	402	528	670	829	1,005
	Horizontal	40	62	145	255	394	560	755
Haskell	Conventional	212	297	407	534	677	838	1,016
	Horizontal	496	783	1,816	3,201	4,938	7,025	9,465
Hughes	Woodford Shale	2,194	3,185	6,141	4,365	3,320	1,886	62
Jackson	Conventional	6	8	12	15	19	24	29
	Horizontal	13	21	48	85	131	187	252
Jefferson	Conventional	26	36	50	65	83	103	125
	Horizontal							

Table 14 – Estimated Demand from Oil and Gas Activities by Drilling Type (AFY)

County	Drilling Type	Estimated Water Demand (AFY)						
		2008	2010	2020	2030	2040	2050	2060
Johnston	Conventional	2	2	3	4	5	6	8
	Horizontal	59	94	217	383	591	840	1,132
Kay	Conventional	115	161	220	289	366	453	550
	Horizontal							
Kingfisher	Conventional	140	196	268	351	446	552	669
	Horizontal	13	21	48	85	131	187	252
Kiowa	Conventional	39	55	75	99	125	155	188
	Horizontal							
Latimer	Conventional	329	462	632	829	1,052	1,302	1,578
	Horizontal	38	59	138	243	375	533	719
Le Flore	Conventional	179	251	344	451	573	709	859
	Horizontal	455	718	1,665	2,935	4,527	6,442	8,679
Lincoln	Conventional	176	246	337	442	561	694	841
	Horizontal	155	244	567	1,000	1,542	2,194	2,956
Logan	Conventional	168	235	322	422	536	663	804
	Horizontal	102	160	372	656	1,012	1,440	1,941
Love	Conventional	30	43	58	77	97	120	146
	Horizontal							
Major	Conventional	438	614	841	1,102	1,399	1,732	2,099
	Horizontal	13	21	48	85	131	187	252
Marshall	Woodford Shale	299	434	836	594	452	257	8
Mayes	Conventional	18	25	34	45	57	71	86
	Horizontal							
McClain	Conventional	116	162	222	291	370	458	555
	Horizontal	13	21	48	85	131	187	252
McCurtain	Conventional	0	0	1	1	1	1	1
	Horizontal							
McIntosh	Conventional	128	179	245	321	407	504	611
	Horizontal	273	430	998	1,758	2,712	3,859	5,199
Murray	Conventional	26	36	49	65	82	102	123
	Horizontal							
Muskogee	Conventional	29	40	55	72	91	113	137
	Horizontal	26	42	97	170	262	373	503
Noble	Conventional	254	356	487	639	811	1,003	1,216
	Horizontal	18	28	64	113	175	249	335
Nowata	Conventional	283	397	543	712	904	1,118	1,356
	Horizontal							
Okfuskee	Conventional	130	183	250	328	417	516	625
	Horizontal	44	69	161	284	437	622	839
Oklahoma	Conventional	165	232	317	416	528	654	792
	Horizontal	31	49	113	199	306	436	587
Okmulgee	Conventional	123	173	237	310	394	488	591
	Horizontal	13	21	48	85	131	187	252
Osage	Conventional	369	517	708	928	1,178	1,458	1,767
	Horizontal							
Ottawa	*No drilling activity*							
Pawnee	Conventional	35	49	67	89	112	139	169
	Horizontal	13	21	48	85	131	187	252
Payne	Conventional	130	182	249	326	414	513	621
	Horizontal	36	56	131	231	356	507	683
Pittsburg	Woodford Shale	5,838	8,477	16,343	11,617	8,836	5,019	165
Pontotoc	Conventional	118	166	227	297	377	467	566

Table 14 – Estimated Demand from Oil and Gas Activities by Drilling Type (AFY)

County	Drilling Type	Estimated Water Demand (AFY)						
		2008	2010	2020	2030	2040	2050	2060
	Horizontal	13	21	48	85	131	187	252
Pottawatomie	Conventional	97	136	187	245	311	385	467
	Horizontal	117	184	426	752	1,159	1,649	2,222
Pushmataha	Conventional	10	14	19	25	32	39	48
	Horizontal							
Roger Mills	Conventional	675	947	1,296	1,700	2,157	2,670	3,236
	Horizontal	59	93	217	382	589	838	1,129
Rogers	Conventional	78	109	150	196	249	308	374
	Horizontal	31	49	113	199	306	436	587
Seminole	Conventional	193	271	371	486	617	764	926
	Horizontal	106	166	386	681	1,050	1,494	2,012
Sequoyah	Conventional	40	57	78	102	129	160	194
	Horizontal							
Stephens	Conventional	467	655	896	1,175	1,492	1,846	2,237
	Horizontal	33	52	121	213	328	467	629
Texas	Conventional	504	707	967	1,269	1,611	1,993	2,416
	Horizontal	103	163	378	666	1,028	1,463	1,971
Tillman	Conventional	14	20	27	36	45	56	68
	Horizontal	13	21	48	85	131	187	252
Tulsa	Conventional	65	91	124	163	207	256	311
	Horizontal	24	37	87	153	236	336	453
Wagoner	Conventional	54	76	104	137	174	215	260
	Horizontal	26	42	97	170	262	373	503
Washington	Conventional	242	339	464	609	773	957	1,160
	Horizontal							
Washita	Conventional	267	375	513	673	854	1,057	1,282
	Horizontal	289	455	1,056	1,862	2,872	4,086	5,505
Woods	Conventional	348	488	668	876	1,113	1,377	1,669
	Horizontal	13	21	48	85	131	187	252
Woodward	Conventional	434	609	834	1,093	1,388	1,717	2,081
	Horizontal							
Statewide Total	Conventional	11,192	15,691	21,479	28,168	35,758	44,248	53,640
	Horizontal	3,226	5,086	11,803	20,805	32,090	45,660	61,514
	Woodford Shale	14,689	21,329	41,120	29,229	22,231	12,627	416
	Total All Drilling	29,107	42,107	74,403	78,202	90,080	102,536	115,570

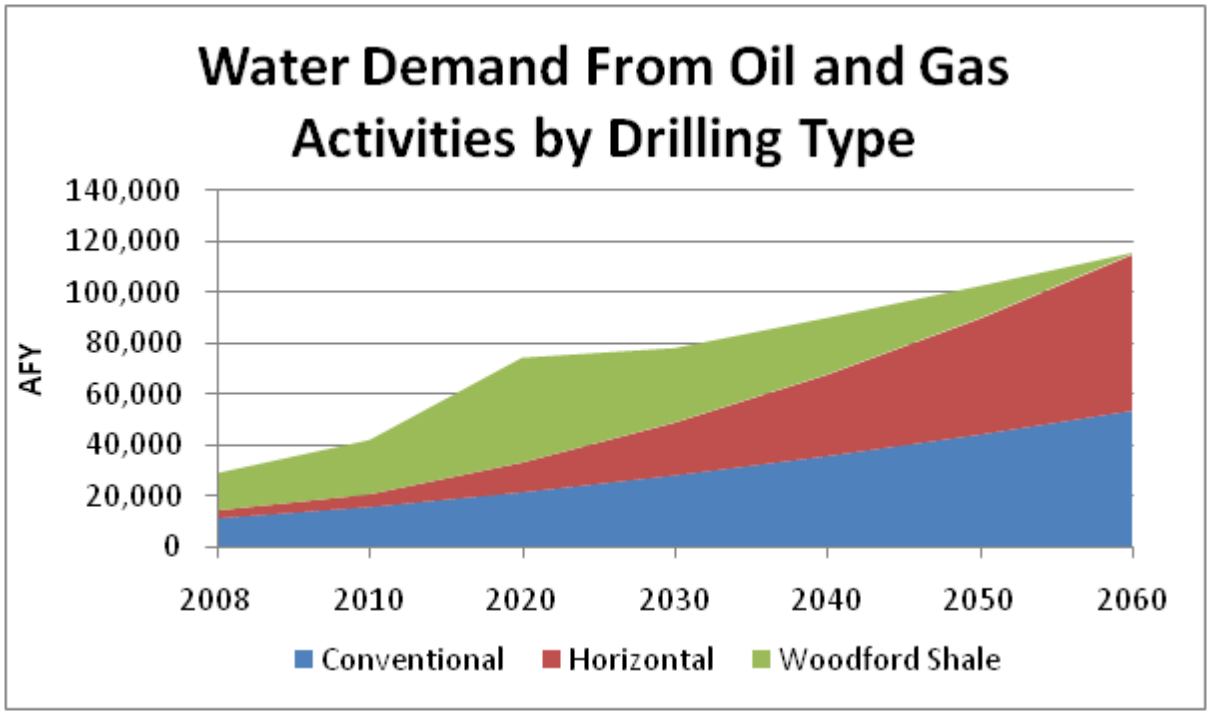

Figure 7 - Water Demands from Oil and Gas Activities by Drilling Type

4.3 Thermoelectric Power

The generation of electricity at thermoelectric power plants requires the use of water for cooling the equipment and condensing steam. Both withdrawal and consumption rates vary by plant because of variations in heat source, prime mover, cooling system type, evaporation rates, and thermal efficiency[6]. For example, close-looped cooling systems require less water to be withdrawn than what is required for once-through cooling; however, nearly all water is consumed in the close-looped process and very little withdrawn water is consumed in once-through cooling.

For completeness in the OCWP, all thermoelectric power plants are included in this sector, even though several power plants receive water from municipal sources. The M&I forecast does not include water provided to thermoelectric power plants, as water use factors for NAICS code 22 (Utilities) captures water used for employee sanitary purposes only. See Section 3.3 for additional information on the nonresidential M&I forecast.

Several data sources were combined to produce the thermoelectric power water demand forecast for Oklahoma, as discussed in the following sections.

[6] Source: Chicago Metropolitan Agency for Planning, *Regional Water Demand Scenarios for Northeastern Illinois,* Chapter 3, June 2008.

4.3.1 Methodology

Estimates of the gallons per day needed by thermoelectric power plants per megawatt-hour (MWh) are developed for both consumptive use and total withdrawal. The unit use (gallons per MWh) is multiplied by the MWh generated to provide an estimate of water needs for power generation for those counties with power generating facilities.

The Department of Energy, Energy Information Administration (EIA), 2008 Annual Energy Outlook (AEO) estimates that U.S. electric consumption will increase at a rate of 1.1 percent per year to the year 2030. "In comparison, electricity consumption grew by annual rates of 4.2 percent, 2.6 percent, and 2.3 percent in the 1970s, 1980s, and 1990s, respectively. The reduced rate of growth in the AEO 2008 results from slower economic growth, the imposition of new efficiency standards in EISA2007, and higher electricity prices" (AEO 2008, pg 11).

CDM assumed (1) a linear relationship between the amount of electricity generated and the amount of water used (i.e., the rate of water use will be constant) and (2) an annual growth rate of 1.1 percent to project future water use from thermoelectric power plants in Oklahoma.

4.3.2 Data

In Oklahoma, there are 58 power-producing plants—11 hydroelectric, 5 wind, 26 natural gas, 6 distillate fuels, 7 coal, and 3 miscellaneous (municipal solid waste, black liquor, and wood). Net electricity generation from natural gas-fired and coal-fired plants is nearly 95 percent of the total generation[7].

Information obtained from the Oklahoma Office of the Secretary of Energy (http://energy.ok.gov) included the plant name, owning utility, and rated generating capacity in megawatts (MW). Information obtained from the U.S. Department of Energy, (EIA) included the plant name, location, 2004 net MWh generated, and 2007 net MWh generated. Comparison of the 2004 generated MWh with the rated generating capacity of each plant indicated a statewide weighted-average operation at 24.8 percent of rated capacity. Comparison of the 2007 generated MWh indicated an average operation of facilities at 34.2 percent of capacity.

EIA information also included the water source and the operating status (i.e., retired, pending) of each facility. OWRB permit data for power generation (purpose code 04) included plant name, county, operating status (i.e., active, inactive), water code (i.e., groundwater, surface water source) and permitted water withdrawal in AF for 2004 through 2007. In addition, USGS 2005 data provides estimates of water use for thermoelectric power which includes surface water million gallons per day (mgd), groundwater mgd, total mgd withdrawals, and gigawatt hours (GWh) generated by county.

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[7] Obtained from the EIA website: http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=OK#related_reports

Power plants were grouped by county in order to provide a county-level estimate of water demand for power generation. Information for retired facilities was included in the computation of average rate of water use per MWh generated but not in projected water use. Data for two facilities included permitted water withdrawals from different counties. The Seminole plant located in Seminole County also has permit rights to withdraw water from Pontotoc County and Atoka County. However, the permitted withdrawal amounts for Pontotoc and Atoka Counties are minimal. Thus, these withdrawals were combined and listed collectively under Seminole County. The Sooner plant in Noble County draws water from Sooner Lake in Pawnee County and is listed under Pawnee County.

A recent study on water needs for energy development in northwest Colorado (Energy Development Water Needs Assessment, Phase I Report, URS Corporation, September 2008) identifies a unit water demand of 0.48 gallons per kilowatt hour (or 480 gallons per MWh) for electric power generation. This estimate represents the water demand for consumptive water use in a power facility. A study by LimnoTech, Inc. (John R. Wolfe, presented at Hydrovison 2008 Conference, Sacramento, California) also reported that water consumption for cooling towers at fossil-fuel thermoelectric power facilities was 480 gallons per MWh.

A review of the mgd withdrawal per gigawatt generated as estimated by the USGS 2005 data for Oklahoma indicates a statewide average of 773 gallons per MWh. CDM assumed 775 gallons per MWh for total water withdrawal for all facilities except for OGE Energy Corporation's (OGE) facilities in Muskogee, Pawnee, and Seminole Counties. OGE requested that annual water use reported to the OWRB be used in order to include water used to maintain lake levels and for cleaning purposes at these facilities. Due to substantial fluctuations in reported water use for years 2005 through 2008, the average of these years was used for purposes of this report.

4.3.3 Forecast

Results by county for water withdrawals and water consumption by thermoelectric power plants are shown in Table 15 and Table 16, respectively. Statewide water withdrawals and consumption are estimated to increase by 79 percent over the forecast period. The statewide totals are shown in Figure 8. It should be noted that this forecast does not include water demands for three pending power facilities. The generating capacity of these facilities is not known at this time. These facilities are located in Grady County, Stephens County, and Pittsburg County.

Table 15 - Estimated Total Withdrawals from Thermoelectric Power Generation (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Caddo	5,010	5,178	5,776	6,444	7,189	8,020	8,947
Canadian	2,288	2,364	2,637	2,942	3,282	3,662	4,085
Choctaw	7,069	7,304	8,149	9,091	10,142	11,314	12,623
Comanche	2,484	2,566	2,863	3,194	3,563	3,975	4,435
Le Flore	5,695	5,885	6,565	7,324	8,171	9,116	10,170
Logan	242	250	279	312	348	388	433
Mayes	4,346	4,491	5,010	5,589	6,236	6,956	7,761
McClain	6,329	6,540	7,296	8,139	9,080	10,130	11,301

Table 15 - Estimated Total Withdrawals from Thermoelectric Power Generation (AFY)

County	2007	2010	2020	2030	2040	2050	2060
McCurtain	956	988	1,103	1,230	1,372	1,531	1,708
Muskogee	100,057	103,395	115,348	128,683	143,560	160,157	178,672
Oklahoma	9,727	10,051	11,213	12,510	13,956	15,569	17,369
Pawnee	36,650	37,872	42,251	47,135	52,584	58,663	65,445
Pittsburg	12,886	13,316	14,855	16,572	18,488	20,626	23,010
Rogers	22,905	23,669	26,405	29,458	32,863	36,662	40,901
Seminole	17,320	17,898	19,967	22,275	24,851	27,723	30,929
Tulsa	13,071	13,507	15,069	16,811	18,754	20,922	23,341
Wagoner	4,580	4,733	5,280	5,891	6,572	7,332	8,179
Woodward	514	531	593	661	738	823	918
Statewide Total	**252,127**	**260,539**	**290,660**	**324,262**	**361,750**	**403,571**	**450,227**

Table 16 - Estimated Consumptive Use from Thermoelectric Power Generation (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Caddo	3,103	3,207	3,578	3,991	4,453	4,967	5,542
Canadian	1,417	1,464	1,633	1,822	2,033	2,268	2,530
Choctaw	4,378	4,524	5,047	5,631	6,281	7,008	7,818
Comanche	1,538	1,590	1,773	1,978	2,207	2,462	2,747
Le Flore	3,527	3,645	4,066	4,536	5,061	5,646	6,299
Logan	150	155	173	193	215	240	268
Mayes	2,692	2,782	3,103	3,462	3,862	4,309	4,807
McClain	3,920	4,051	4,519	5,041	5,624	6,274	7,000
McCurtain	592	612	683	762	850	948	1,058
Muskogee	61,970	64,038	71,441	79,701	88,915	99,194	110,661
Oklahoma	6,024	6,225	6,945	7,748	8,644	9,643	10,758
Pawnee	22,699	23,456	26,168	29,193	32,568	36,334	40,534
Pittsburg	7,981	8,247	9,201	10,264	11,451	12,775	14,251
Rogers	14,186	14,659	16,354	18,245	20,354	22,707	25,332
Seminole	10,727	11,085	12,367	13,796	15,391	17,171	19,156
Tulsa	8,096	8,366	9,333	10,412	11,615	12,958	14,456
Wagoner	2,837	2,932	3,270	3,648	4,070	4,541	5,066
Woodward	318	329	367	410	457	510	569
Statewide Total	**156,156**	**161,366**	**180,022**	**200,833**	**224,051**	**249,953**	**278,850**

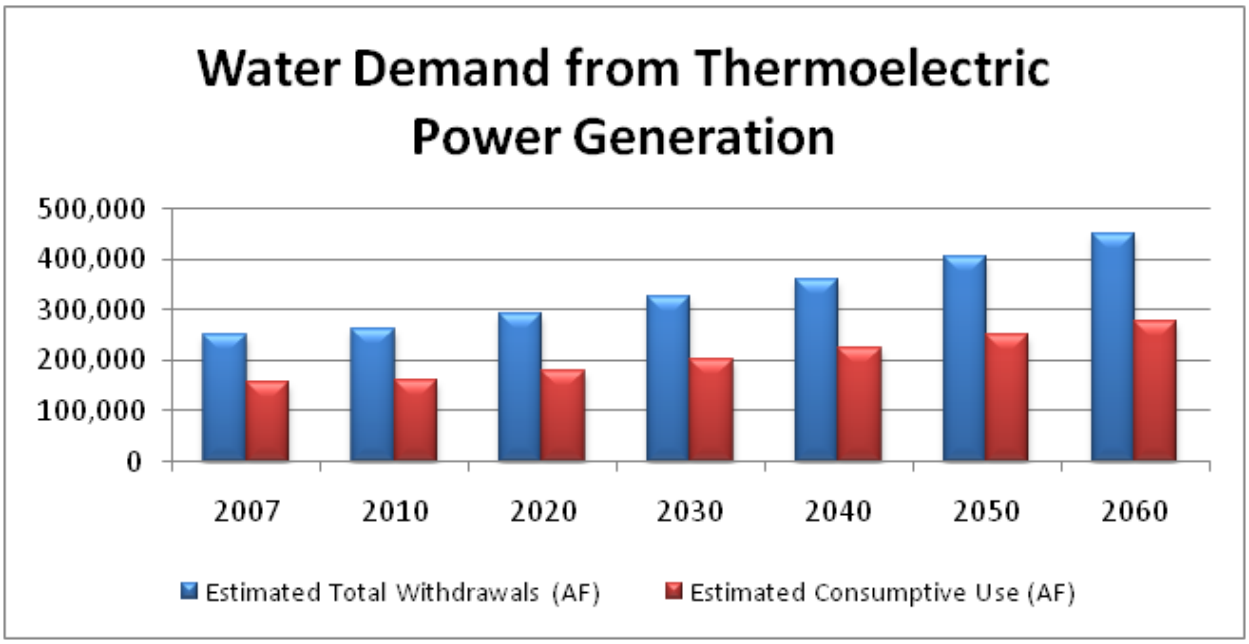

Figure 8 - Water Demand from Thermoelectric Power Generation

4.4 Other Large Industry

A sector was added to the OCWP demand forecast to represent water use from large self-supplied industrial users, such as sand companies, gypsum production plants, quarry mines, concrete producing plants, petroleum refineries, paper mills, sawmills, bottling and distributing plants, chemical plants, tire manufacturing plants, lime production, natural gas plants, and meat packing plants. The data used in this sector were obtained from OWRB annual surface and groundwater reports. Two pieces of information were needed to include a large industry in this forecast sector—water use and employment. Water use reporting was needed to have an accurate estimate of current use at the given establishment. Employment numbers were needed in order to subtract employment from the employment projections used in the public-supply nonresidential forecast, to avoid double-counting.

Twenty-seven industries reported the needed data to the OWRB and are included in this forecast sector. In order to maintain privacy of these establishments, individual information is withheld in this report.

Because future conditions at these establishments is unknown, this sector was forecasted into the future using the growth rates of the employment projections developed for the public supply nonresidential forecast. Growth rates were specified by industry type. Results of the demand forecast are shown in Table 17 and illustrated in Figure 9. Water use among these large industries is projected to increase by about 20 percent by 2060.

Table 17 - Selected Self-Supply Large Industry Water Demand Forecast (AFY)

County	2006	2010	2020	2030	2040	2050	2060
Beaver	364	375	393	400	406	413	419
Blaine	317	311	304	330	357	383	412
Canadian	118	115	113	121	127	134	140
Carter	61	63	66	70	73	77	81
Choctaw	92	95	99	101	104	101	99
Comanche	362	355	346	363	377	387	396
Custer	24	23	23	23	24	25	26
Garvin	230	225	219	223	227	232	236
Jackson	613	601	586	614	636	654	669
Johnston	1,425	1,397	1,359	1,380	1,400	1,440	1,481
Kay	11,004	11,340	11,880	12,184	12,465	12,746	13,050
Logan	1,200	1,176	1,154	1,268	1,382	1,493	1,612
McCurtain	34,739	34,058	33,179	34,339	35,320	36,390	37,371
Muskogee	22,068	21,658	21,112	21,746	22,293	22,841	23,388
Oklahoma	249	244	238	247	255	260	265
Osage	587	576	562	590	615	640	669
Pottawatomie	651	639	623	661	697	732	768
Sequoyah	1,742	1,708	1,672	1,825	1,974	2,127	2,280
Texas	10,938	10,724	10,612	12,722	14,831	16,941	19,018
Woodward	3,159	3,097	3,016	3,106	3,167	3,242	3,303
Statewide Total	**89,942**	**88,780**	**87,558**	**92,313**	**96,730**	**101,258**	**105,683**

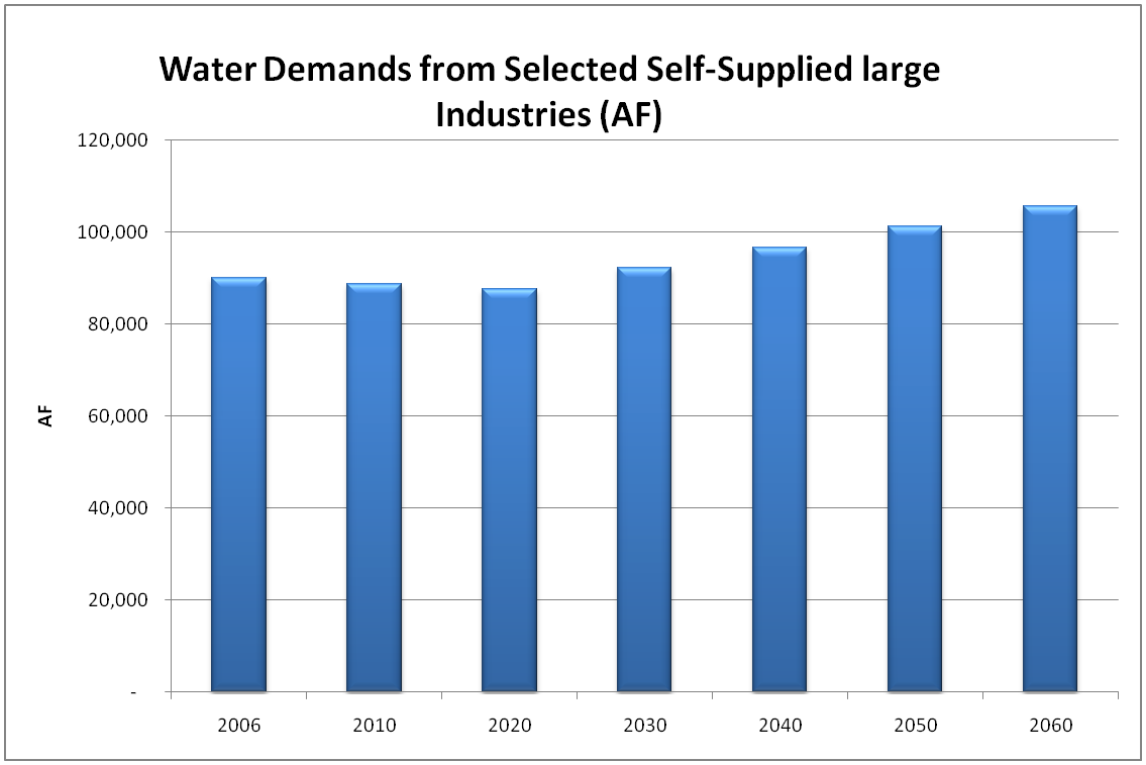

Figure 9 - Water Demands from Selected Self-Supplied Large Industries (AFY)

Section 5
Agriculture

Oklahoma is the fifth largest cattle producing state in the nation and the third largest producer of wheat. In recent years, crops and livestock that were once relatively small in terms of production have grown dramatically, such as poultry and swine (Oklahoma Department of Agriculture). Agricultural water demands represent a significant percent of statewide water withdrawals and support an important economic sector. For the OCWP, current and future agriculture demands are estimated by county for two sub-sectors: livestock and crop irrigation.

The forecast presented in this chapter represent the ***base*** agriculture forecast. That is, a forecast that represents current water use patterns and attitudes, current market conditions, and average weather from the base year throughout the forecast. The 2060 demands represent a reasonable maximum estimate of water requirements under base conditions.

Alterations in the base conditions have the potential to greatly impact the future of agriculture water requirements. Conservation practices that replace inefficient irrigation systems with low-waste irrigation systems can reduce irrigation water demands. Potential climate change can alter the type of crops irrigated, reduce or increase rainfall amounts, and affect crop yields. Future energy policies may encourage a switch to biofuel crops that require varying amounts of irrigation water and bring new industries that use high volumes of water. An impact assessment of conservation, climate change, and other factors on the base forecast will be addressed for the OCWP in a later task.

The Census of Agriculture (Ag Census) is the main source of data utilized for the agriculture water demand forecast. Taken every 5 years by the United States Department of Agriculture (USDA), the Ag Census is a complete count of U.S. farms and ranches and the people who operate them. The most recent Ag Census was conducted in 2007 and reports on land use and ownership; operator characteristics; production practices including irrigation, income, and expenditures; livestock counts; and many other areas.

5.1 Livestock

Livestock require water for animal nutrition, animal cooling, sanitation, and waste removal. Oklahoma ranks 13th in the U.S. for live animal and meat exports and produces 5 percent of U.S. cattle and calves inventory (United 2008). Poultry and swine, respectively, are Oklahoma's second and third largest agricultural industries and Oklahoma is now one of the top states in poultry and swine production (Oklahoma 2009).

Current estimates of livestock water demands were developed based on the major livestock groups in Oklahoma and their respective daily water requirements. Major

livestock groups evaluated are: cattle, dairy cows, sheep, hogs, horses, and poultry.[8] The annual livestock water demand was calculated by multiplying the daily water requirement for each group by the number of livestock and then the number of days in a year. The annual demand in gallons is then converted to AFY. This computation is shown in Equation 5.

$$QLS_{c,y}^{AFY} = \left[\sum\left(LSC_{c,y}^{n} \times DWR^{n} \times 365\right)\right]/321{,}851 \qquad \textit{Equation 5}$$

Where:

- $QLS_{c,y}^{AFY}$ = Livestock water demand in AFY in county (c) in year (y)
- $LSC_{c,y}^{n}$ = Livestock count for animal group (n) in county (c) and year (y)
- DWR^{n} = Daily water requirement per animal (n)

5.1.1 Livestock Inventories

Base year livestock numbers at the county level were obtained from the 2007 Ag Census.

Due to disclosure obligations in hog data, some county hog numbers were not reported in the Ag Census. In these instances, 2007 National Agricultural Statistics Service (NASS) district values were used to determine hog numbers. These 2007 district values were distributed to withheld counties by using the county ratios from 1992 to determine 2007 county/district ratios. 1992 ratios were used as 1992 was the last census to contain a data set with no undisclosed data.

It should be noted that 2007 is the first year for horse counts in the Ag Census and the values are known to be low. The American Horse Council (AHC) reports a statewide total nearly three times what is reported in the Ag Census and is considered to have greater accuracy. However, the AHC does not provide horse estimates by county, as needed for the OCWP. Through contact with the Oklahoma State University horse specialist, it was determined that the 2007 Ag Census was the best source for county horse counts.

Also, because cattle for beef and dairy cows have differing water requirements, these livestock groups were estimated separately. Dairy cow inventory estimates were subtracted from total cattle counts to obtain the estimated beef cattle inventory. Therefore, beef cattle values in this analysis represent all cattle other than dairy cows.

Once current livestock inventories by county were collected, a methodology was developed to project livestock inventories by county to 2060. In order to estimate a reasonable maximum projection for livestock, an analysis was conducted from the three most recent Ag Census years. The Ag Census data from 1997, 2002, and 2007 were analyzed to obtain the highest reported number of livestock by livestock group in each county. It is

[8] Poultry includes: broilers, layers, and pullets for replacement.

believed that using the highest reported number allows for maximum future fluctuations due to unforeseen circumstances. The historical maximum was then assumed to be the build-out inventory for 2060. Linear interpolation was applied to obtain the inventory for forecast years between 2007 and 2060. In some instances, 2007 represents the highest livestock count for a given county and animal group, in which case no growth is assumed.

A modified methodology was used to estimate the build-out inventory for poultry because many county values were withheld in the three census datasets. For instance, in the 1997 census, data on layers were withheld totaling 1.8 million birds across 15 counties. In general, the highest poultry count by type was obtained for these counties and used as build-out. Overall, data problems experienced in the chicken livestock group has little effect on the livestock water demand forecast due to the low water requirement for chickens.

Also, 2007 was the first year that data were collected on equine, thus no historical maximum data exist to estimate future build-out inventories for horses. To project the number of horses into the future, a 2 percent growth rate over the study period was assumed.

Results of the 2007 Ag Census and the 2060 build-out assumptions for each livestock group are shown in Table 18. Statewide, growth in cattle and hog production could potentially increase by 5.8 and 6.3 percent, respectively. Growth in dairy cows has the potential to increase by 65.3 percent. The poultry and sheep/goat livestock groups could increase by 5.0 and 10.1 percent by 2060, respectively. The horse inventory shows the assumed 2 percent growth.

Table 18 - Projected Livestock Inventory

	CATTLE		DAIRY COWS		SHEEP & GOATS		HOGS		CHICKEN		HORSES	
County	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**
Adair	57,391	57,650	3,541	7,526	2,103	2,103	372	406	4,789,544	5,029,021	2,330	2,377
Alfalfa	91,893	103,937	632	632	934	1,703	469	8,154	440	462	810	826
Atoka	80,155	79,988	167	221	2,354	2,354	91	341	1,447	2,315	1,954	1,993
Beaver	101,119	120,597	70	430	545	729	332,088	332,088	207	403	1,085	1,107
Beckham	53,256	63,154	632	632	1,054	1,518	365	390	456	479	1,271	1,296
Blaine	112,977	112,112	865	865	1,323	1,323	65	507	0	0	742	757
Bryan	100,684	101,561	4,080	4,188	4,087	5,455	926	926	1,571	2,705	2,616	2,668
Caddo	141,988	141,725	263	355	3,807	3,807	65,162	65,162	2,090	2,195	1,851	1,888
Canadian	106,430	107,208	322	1,361	2,486	3,402	3,476	8,772	2,491	2,616	2,898	2,956
Carter	53,862	60,442	58	124	2,213	2,213	520	748	4,067	4,270	2,948	3,007
Cherokee	47,048	46,612	2,436	2,528	3,862	3,862	266	901	527,221	548,214	2,803	2,859
Choctaw	70,402	70,338	64	242	1,696	1,696	243	383	158,038	165,940	2,966	3,025
Cimarron	126,552	134,887	632	2,318	445	445	32,309	32,309	166	174	523	533
Cleveland	24,481	26,938	231	410	5,141	5,141	2,584	6,498	3,863	4,172	4,077	4,159
Coal	39,788	47,032	684	961	1,252	2,670	2,101	4,098	1,309	1,460	1,072	1,093
Comanche	70,163	71,747	583	2,759	2,420	2,420	293	551	1,527	1,603	2,168	2,211
Cotton	67,183	69,983	632	632	443	443	31	298	228	239	832	849
Craig	108,594	109,030	764	1,081	10,606	10,606	592	592	1,267,182	1,330,541	2,880	2,938
Creek	42,372	44,655	113	926	4,886	4,886	926	3,274	27,441	36,441	4,267	4,352
Custer	85,940	101,660	663	683	1,942	2,386	8,492	8,492	707	1,050	1,019	1,039
Delaware	80,997	81,066	2,131	3,727	4,064	4,064	445	37,477	10,634,551	11,166,279	2,791	2,847
Dewey	51,588	62,153	11	248	519	968	366	366	685	719	571	582
Ellis	62,396	65,421	304	859	449	938	102,233	102,233	269	282	769	784
Garfield	97,462	99,394	719	851	2,535	4,010	315	1,096	1,144	1,324	962	981
Garvin	83,643	83,918	225	946	3,677	3,677	502	663	2,546	2,673	3,754	3,829
Grady	100,915	112,979	14,930	21,226	6,586	6,586	32,024	32,024	1,882	1,976	2,981	3,041
Grant	47,705	59,328	632	632	2,460	2,460	175	1,576	523	549	560	571
Greer	32,033	32,033	0	52	1,903	1,903	65	214	156	164	475	485
Harmon	39,558	38,926	632	2,318	621	621	201	1,461	0	0	206	210
Harper	90,331	93,146	632	632	921	1,391	37,371	37,371	63	66	678	692
Haskell	59,074	59,060	14	554	396	786	9,190	14,565	2,982,125	3,131,231	1,531	1,562
Hughes	70,781	70,643	138	207	3,187	3,187	130,744	149,488	1,386	1,419	1,929	1,968
Jackson	41,434	56,101	40	2,318	2,018	2,018	117	362	184	193	903	921
Jefferson	94,869	94,684	185	749	1,082	1,931	55	145	163	304	792	808
Johnston	42,655	43,722	24	865	5,476	5,476	3,018	3,018	1,240	1,302	1,276	1,302
Kay	42,818	46,077	12	997	7,014	7,014	488	2,384	1,325	3,864	1,335	1,362
Kingfisher	115,341	121,549	1,631	1,750	2,800	2,943	110,302	110,302	553	1,098	1,202	1,226

Table 18 - Projected Livestock Inventory

	CATTLE		DAIRY COWS		SHEEP & GOATS		HOGS		CHICKEN		HORSES	
County	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**
Kiowa	78,546	81,706	7	129	1,679	2,460	2,115	2,115	371	390	672	685
Latimer	37,028	36,995	33	102	2,869	2,869	3,557	7,260	250,752	263,290	1,595	1,627
Leflore	85,463	85,212	251	281	3,974	3,974	7,609	14,262	12,309,329	12,924,795	3,516	3,586
Lincoln	70,357	69,912	2,245	2,324	5,932	5,932	785	2,601	4,760	4,998	4,902	5,000
Logan	49,120	66,483	215	529	4,852	5,854	296	454	3,572	3,751	3,479	3,549
Love	46,133	46,083	50	50	1,526	1,526	136	144	418	439	2,150	2,193
Major	83,158	91,763	715	885	2,318	2,318	153,345	153,345	1,485	1,559	960	979
Marshall	20,939	25,102	44	749	1,990	1,990	295	295	2,080	2,184	1,320	1,346
Mayes	80,162	79,427	4,335	5,415	2,626	2,626	676	2,127	1,859,844	1,952,836	3,251	3,316
McClain	58,933	58,434	1,399	2,007	1,762	2,827	2,265	5,485	2,713	2,849	3,519	3,589
McCurtain	68,314	78,240	198	777	2,916	2,916	8,354	39,720	9,999,815	10,444,351	3,877	3,955
McIntosh	43,835	50,058	54	532	772	772	6,943	6,943	76,734	80,571	2,440	2,489
Murray	26,199	32,017	632	2,586	1,149	2,748	57	320	1,912	2,008	865	882
Muskogee	73,887	74,249	1,138	1,798	5,894	5,894	421	662	325,373	341,642	3,833	3,910
Noble	63,398	63,314	84	242	1,902	2,409	181	1,139	525	580	960	979
Nowata	78,177	77,545	632	632	1,034	1,950	52	302	37,665	39,549	1,998	2,038
Okfuskee	43,122	46,120	26	52	1,593	1,593	24,280	24,280	2,023	5,248	1,392	1,420
Oklahoma	20,668	21,713	632	632	4,005	4,005	721	847	4,446	4,668	4,028	4,109
Okmulgee	51,310	51,820	11	180	2,406	2,406	604	802	3,781	3,970	3,287	3,353
Osage	165,776	172,283	383	663	2,931	3,575	273	1,441	2,199	3,320	4,858	4,955
Ottawa	58,393	58,489	404	1,911	2,325	2,325	513	2,707	2,163,029	2,271,180	1,781	1,817
Pawnee	43,444	43,383	61	61	2,585	3,336	150	1,145	1,204	2,220	1,673	1,706
Payne	53,024	53,368	1,290	2,244	5,101	5,101	1,821	2,397	4,511	4,576	3,243	3,308
Pittsburg	82,079	87,266	416	416	3,416	3,416	485	713	53,476	56,150	3,080	3,142
Pontotoc	53,585	58,836	544	953	4,663	4,663	8,410	8,410	3,358	3,526	3,962	4,041
Pottawatomie	56,897	57,151	746	1,086	3,426	3,426	18,556	18,556	6,171	6,480	3,724	3,798
Pushmataha	33,664	36,212	60	81	1,392	1,392	166	1,002	33,725	35,411	2,263	2,308
Roger Mills	62,516	67,821	193	1,740	886	886	239	395	596	626	886	904
Rogers	76,585	76,794	391	1,300	4,162	4,162	304	609	4,292	4,507	4,489	4,579
Seminole	36,895	39,965	209	644	1,883	1,883	16,964	20,680	2,738	2,875	2,125	2,168
Sequoyah	40,701	51,266	632	632	2,424	2,424	2,024	3,017	876,386	920,205	3,361	3,428
Stephens	71,412	78,530	105	895	2,604	2,604	888	1,298	1,938	2,079	2,797	2,853
Texas	246,850	282,969	90	276	1,294	1,294	1,145,999	1,145,999	509	701	2,362	2,409
Tillman	47,919	49,859	5,890	5,890	849	1,837	310	310	308	372	683	697
Tulsa	20,681	21,727	100	117	2,792	2,792	91	791	3,215	3,376	3,545	3,616
Wagoner	42,537	42,247	690	1,072	2,952	2,952	290	420	7,809	8,199	2,353	2,400
Washington	34,980	35,920	67	101	1,597	1,597	1,527	1,527	1,665	1,748	3,762	3,837

Table 18 - Projected Livestock Inventory

	CATTLE		DAIRY COWS		SHEEP & GOATS		HOGS		CHICKEN		HORSES	
County	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**	**2007**	**2060**
Washita	107,650	107,318	632	632	1,085	2,253	5,473	5,473	273	287	664	677
Woods	96,714	107,181	632	632	826	826	201	504	301	316	869	886
Woodward	85,708	85,617	91	112	1,819	2,966	134,826	134,826	490	1,084	1,204	1,228
State Total	5,332,637	5,641,850	66,023	109,168	201,518	221,914	2,431,185	2,584,958	48,474,581	50,856,658	165,555	168,866

*(D) indicates data withheld due to privacy agreements.
** Indicated data available only for broilers

5.1.2 Livestock Water Requirements

To complete the livestock water demand projections, data on daily animal water requirements were assumed from USGS Method for Estimating Water Withdrawals for Livestock in the U.S. (USGS 2005). Daily water requirements for each livestock group include that used for drinking water, cooling, and sanitation and waste removal requirements. A literature review was also conducted to verify the USGS water requirements, as discussed below. A summary of daily animal water requirements selected for the OCWP are presented in Table 19.

Table 19 - Average Daily Water Requirement per Animal by Livestock Group (gallons)

Cattle	Dairy Cows	Sheep/Goats	Hogs	Chickens	Horses
12.0	35.0	2.0	4.5	0.1	12.0

For cattle, feedlots provide drinking water 24 hours a day in water troughs placed in each pen. Water use at feedlots for beef cattle includes drinking water, trough overflow, trough cleaning, evaporation, and feedmill usage. Parker et al. (2000) performed a 2-year study at a 50,000 head beef cattle feed yard in the Texas High Plains. Flowmeters were installed at the incoming water supply and was monitored daily from November 1995 through October 1997. The average daily water use over the 2 year study period was 10.8 gallons per head per day (ghd), with variation in the summer and winter months. This average water use observed in the Parker et al. study is consistent with other literature reviewed (AGRI-FACTS 2008, Martin et al. 2001, and Ontario 2007). The USGS estimated water requirements for cattle at 12 ghd. Thus, the USGS value is assumed reasonable for the OCWP.

Milk cow operations require water to meet the nutritional needs of the animals and for cleaning the milking parlor and equipment. Brugger and Dorsey (2006) conducted a study in Ohio using 13 water meters to monitor water flows on a 1,000 cow dairy. The meters were used to monitor cow drinking water, plate cooler water, and parlor wash water as well as sanitation of the milking equipment. Cow drinking water varied monthly from 12.0 to 32.4 ghd, with a yearly average of 20.5 ghd. In all, an average of 29.8 ghd was used for drinking and sanitation purposes on the dairy farm. The Brugger and Dorsey study was the only resource found that metered actual water use. Other resources report higher average drinking requirements for dairy cows ranging from 30 to 40 ghd (AGRI-FACTS 2008, Ontario 2007, and Martin et al. 2001) based on estimates of usage. According to the USGS, dairy cows require an average of 35 ghd. Thus for the OCWP, the USGS value is assumed reasonable.

Grazing sheep and goats, particularly in the cooler seasons of the year, can require relatively little additional water beyond what they receive through forage. Ministry (2007) indicates that sheep require 2.6 ghd. According to the USGS, sheep and goats require an average of 2 ghd. This rate of use is assumed as the daily requirement for sheep and goats for the OCWP.

Hog farms require water for animal drinking, cooling, and washing, and for waste disposal. Estimates of drinking water requirements for swine range from 4 to 20 ghd (AGRI-FACTS

2008, and Martin et al. 2001). The USGS reports average daily water demand per hog to 4.5 gallons. This rate of use is assumed as the daily requirement for hogs for the OCWP.

While water demand at poultry facilities can vary depending on individual cleaning programs, water requirements per animal are seemingly low. According to several resources, chickens require 0.1 gallons of water per day (AGRI-FACTS 2008, Bell et al. 2002, and Martin et al. 2001). This is in agreement with the USGS suggested values and assumed to be sufficient for planning purposes.

On average, horses require 12 ghd (AGRI-FACTS 2008, American 2000, Ministry 2007, and Martin 2001). The USGS also reports that horses require 12 ghd. Horses at rest in a moderate climate will generally consume between 4 to 9 gallons for a 1,100-pound horse. Heat and humidity increase water requirements, especially in exercising horses. For the OCWP, 12 gallons per day is assumed for horses in Oklahoma.

5.1.3 Livestock Water Demands

Results of the water demand forecast for livestock are shown in Table 20. Under the assumptions described above, water demand under reasonable maximum conditions grows by 7.4 percent from 2007 to 2060. The highest percent of growth can occur in Jackson, Logan, and Murray Counties, although these counties have relatively low water demands. The highest water demand for livestock (about ten percent of the state total) occurs in Texas County, due to the high numbers of beef cattle and hog farms. Figure 10 shows the statewide demands by livestock group. As shown, cattle and hog operations constitute the majority of the current and future water demands.

Table 20 - Oklahoma: Projected Livestock Water Demand - AFY (All Cattle, Dairy Cows, Sheep/Goats, Chickens, Hogs, and Horses)

County	2007	2010	2020	2030	2040	2050	2060
Adair	1,431	1,441	1,476	1,511	1,546	1,581	1,616
Alfalfa	1,275	1,287	1,326	1,365	1,404	1,442	1,481
Atoka	1,116	1,116	1,117	1,117	1,117	1,118	1,118
Beaver	3,052	3,067	3,120	3,172	3,224	3,276	3,328
Beckham	762	770	795	820	846	871	897
Blaine	1,566	1,565	1,564	1,562	1,560	1,558	1,557
Bryan	1,562	1,564	1,567	1,571	1,575	1,579	1,582
Caddo	2,281	2,281	2,281	2,281	2,281	2,281	2,282
Canadian	1,506	1,510	1,525	1,541	1,556	1,571	1,586
Carter	774	779	797	814	832	849	867
Cherokee	829	829	830	830	831	832	833
Choctaw	1,010	1,010	1,012	1,013	1,015	1,016	1,018
Cimarron	1,897	1,907	1,940	1,974	2,008	2,041	2,075
Cleveland	418	421	433	444	456	467	479
Coal	590	596	619	642	665	688	711
Comanche	1,002	1,008	1,029	1,049	1,070	1,090	1,111
Cotton	940	942	950	957	965	972	979
Craig	1,683	1,684	1,689	1,694	1,699	1,703	1,708
Creek	650	654	668	683	697	712	726
Custer	1,242	1,254	1,294	1,335	1,375	1,415	1,455
Delaware	2,293	2,310	2,368	2,425	2,483	2,540	2,598
Dewey	705	713	742	771	800	828	857
Ellis	1,377	1,381	1,393	1,405	1,417	1,429	1,441

Table 20 - Oklahoma: Projected Livestock Water Demand - AFY (All Cattle, Dairy Cows, Sheep/Goats, Chickens, Hogs, and Horses)

County	2007	2010	2020	2030	2040	2050	2060
Garfield	1,359	1,361	1,368	1,375	1,383	1,390	1,397
Garvin	1,195	1,197	1,203	1,209	1,216	1,222	1,228
Grady	2,158	2,181	2,259	2,336	2,413	2,491	2,568
Grant	680	689	720	751	782	813	843
Greer	442	442	442	443	443	444	444
Harmon	562	565	577	589	602	614	626
Harper	1,439	1,441	1,448	1,456	1,463	1,470	1,478
Haskell	1,163	1,167	1,179	1,191	1,203	1,215	1,227
Hughes	1,649	1,654	1,673	1,691	1,709	1,727	1,745
Jackson	576	592	646	701	755	809	864
Jefferson	1,296	1,297	1,301	1,305	1,310	1,314	1,318
Johnston	619	622	631	640	649	658	667
Kay	612	618	635	652	670	687	705
Kingfisher	2,193	2,198	2,215	2,231	2,248	2,265	2,282
Kiowa	1,080	1,082	1,092	1,101	1,110	1,119	1,129
Latimer	570	571	576	580	584	588	593
LeFlore	2,494	2,499	2,517	2,535	2,553	2,571	2,588
Lincoln	1,117	1,118	1,119	1,121	1,122	1,124	1,125
Logan	728	742	789	837	884	931	978
Love	655	655	655	655	655	655	655
Major	1,937	1,944	1,967	1,990	2,013	2,036	2,060
Marshall	307	312	328	344	359	375	391
Mayes	1,488	1,491	1,500	1,510	1,519	1,529	1,538
McClain	910	912	919	926	933	940	947
McCurtain	2,035	2,055	2,123	2,191	2,259	2,327	2,395
McIntosh	836	844	868	892	916	939	963
Murray	392	401	431	461	491	521	552
Muskogee	1,137	1,139	1,146	1,152	1,159	1,166	1,172
Noble	874	874	876	879	881	883	885
Nowata	1,109	1,109	1,108	1,107	1,106	1,105	1,104
Okfuskee	726	728	736	744	752	760	768
Oklahoma	370	371	374	377	380	383	386
Okmulgee	743	744	747	750	753	756	759
Osage	2,317	2,323	2,343	2,363	2,384	2,404	2,424
Ottawa	1051	1055	1071	1086	1102	1118	1133
Pawnee	616	616	617	618	620	621	622
Payne	828	831	839	848	856	865	874
Pittsburg	1,176	1,181	1,194	1,208	1,221	1,235	1,248
Pontotoc	848	853	870	886	903	919	936
Pottawatomie	946	947	950	954	957	960	964
Pushmataha	493	495	502	510	518	525	533
Roger Mills	863	871	896	921	946	971	996
Rogers	1,116	1,119	1,127	1,134	1,142	1,150	1,158
Seminole	623	627	642	656	671	686	700
Sequoyah	721	730	758	787	816	845	873
Stephens	1,012	1,019	1,044	1,068	1,093	1,117	1,142
Texas	9,133	9,161	9,254	9,347	9,440	9,533	9,626
Tillman	888	889	895	900	905	911	916
Tulsa	337	338	341	345	349	352	356
Wagoner	639	640	642	645	647	649	652
Washington	535	536	539	541	544	547	550
Washita	1,511	1,511	1,510	1,510	1,510	1,509	1,509
Woods	1,339	1,347	1,374	1,401	1,428	1,455	1,482
Woodward	1,856	1,856	1,856	1,857	1,857	1,858	1,858
State Total	94,087	94,480	95,793	97,106	98,418	99,731	101,043

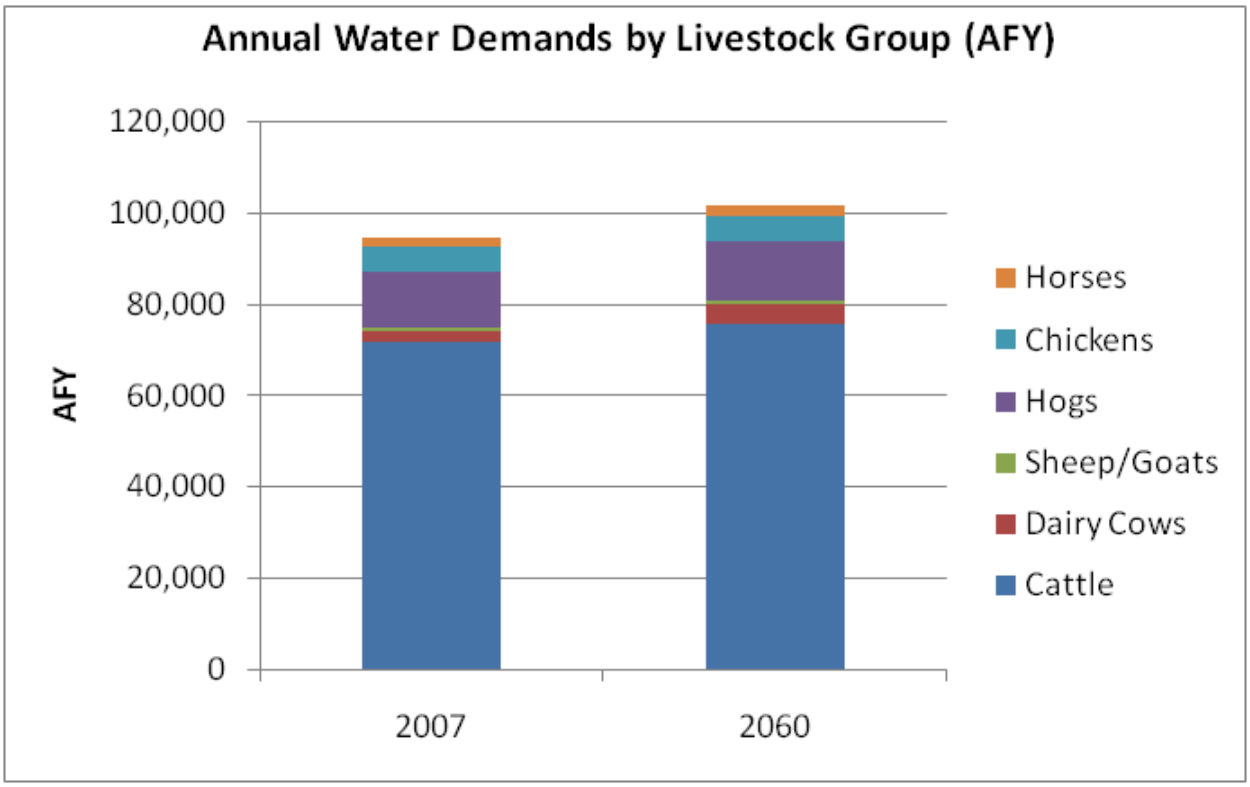

Figure 10 - Annual Water Demands by Livestock Group (AFY)

5.2 Crop Irrigation

Accurately forecasting irrigation water demands in the future for a specific period in time is a challenging task. Variation in weather, politics, and socioeconomic forces cause significant swings in cropping patterns, irrigation use, and ultimately water demand for irrigation. Numerous alternative scenarios could be developed as indicative of future crop irrigation patterns in Oklahoma for the next 50 years. Nonetheless, it is necessary to adopt plausible guidelines to be used in planning for future demands for irrigation water. The demands developed for 2060 under this task represent a reasonable maximum demand for each county under average weather and current economic conditions (i.e., base scenario) that is a useful input into the planning process.

Crop irrigation water demand for a given county is driven by the type of crops planted, irrigation water required for those crops, number of acres planted, and type of irrigation system utilized. A basic methodology was developed based on the best available data to estimate irrigation water demands now and in the future. The methodology is total irrigated acres times the weighted average crop irrigation water requirement (WCIR) per irrigated acre by county, as shown in Equation 6 and 7 and further discussed below.

$$Q_{c,y} = IA_{c,y} \times WCIR_{c,b}$$ *Equation 6*

$$WCIR_{c,b} = \left(\sum_{i}^{1} \left(IA_{c,b}^{Crop_i} \times CIR_{c}^{Crop_i} \right) \right) / IA_{c,b}$$ *Equation 7*

Where:

- $Q_{c,y}$ = Total crop irrigation requirements in AFY in county (c) in year (y)
- $IA_{c,y}$ = Total irrigated acres in county (c) in year (y)
- $WCIR_{c,b}$ = Weighted crop irrigation requirement in county (c) in base year (b) (2007)
- $IA_{c,b}^{Crop_i}$ = Irrigated acres in crop (i) in county (c) in base year (b) (2007)
- $CIR_{c}^{Crop_i}$ = Irrigation water required per acre in AFY for crop (i) in county (c)
- $IA_{c,b}$ = Total irrigated acres in county (c) in the base year (b) (2007)

Determining the WCIR for each county requires several data sources. 2007 Ag Census provides data for irrigated acres by commodity type and county (variable $IA_{c,b}^{Crop_i}$ in Equation 6). The commodities include corn for grain and silage, cotton, barley, edible beans, forage, orchards, oats, peanuts, potatoes, rice, sod, sorghum, soybeans, sunflowers, watermelons, and wheat.[9] In some instances, irrigated acres by crop type were withheld due to privacy agreements. The undisclosed values were estimated by comparing the statewide irrigated acres for a given commodity and evenly distributing the difference between the known values and unknown values to the undisclosed counties.

Total irrigated land by county for 2007 (variable $IA_{c,y}$ in Equation 5) was also obtained from the Ag Census. This Ag Census category includes all land watered by any artificial or controlled means, such as sprinklers, flooding, furrows or ditches, sub-irrigation, and spreader dikes. The Ag Census category irrigated lands is more accurate for total irrigated acres when compared to the sum of irrigated acres by commodity type, which has withheld county data.

Crop irrigation water requirements (variable $CIR_{c}^{Crop_i}$ in Equation 6) were obtained for most of the crops from the Natural Resource Conservation Service (NRCS) Irrigation Guide Report, Oklahoma Supplement (USDA NRCS 1997). The Irrigation Guide provides monthly crop irrigation water requirements at 11 locations in Oklahoma: Altus, Ardmore, Chickasha, Elk City, Goodwell, Hugo, Muskogee, Oklahoma City, Ponca City, Tulsa, and Woodward. Crop types include: alfalfa, corn for silage, corn for grain, cotton, grain for sorghum, peanuts,

[9] "Forage" includes land used for all hay and all haylage, grass silage, and greenchop. "Orchards" includes land in bearing age and nonbearing age fruit trees, citrus or other groves, vineyards, and nut trees. Potatoes, watermelons, and sod are not included in the irrigated commodity table of the Ag Census; these crops are assumed to be irrigated and the data were extracted from the "Planted Acres" table of the Ag Census.

pasture grasses, potatoes, soybeans, spinach, sunflowers, watermelons, and wheat. Irrigation requirements were provided by crop type for both average and dry years. The normal year is for 50 percent chance of effective rainfall and the dry year is for 80 percent chance of effective rainfall. For use in the baseline forecast presented herein, average year requirements were utilized. Crop types from the Ag Census data by county were matched with irrigation requirements in the Irrigation Guide for one of the 11 reporting locations based on distance and rainfall zone. County assignment to location is shown in Figure 11.

The Irrigation Guide did not provide a water requirement for sod. A Bureau of Reclamation (BOR) study completed for the OWRB provided estimates of sod irrigation water requirements.

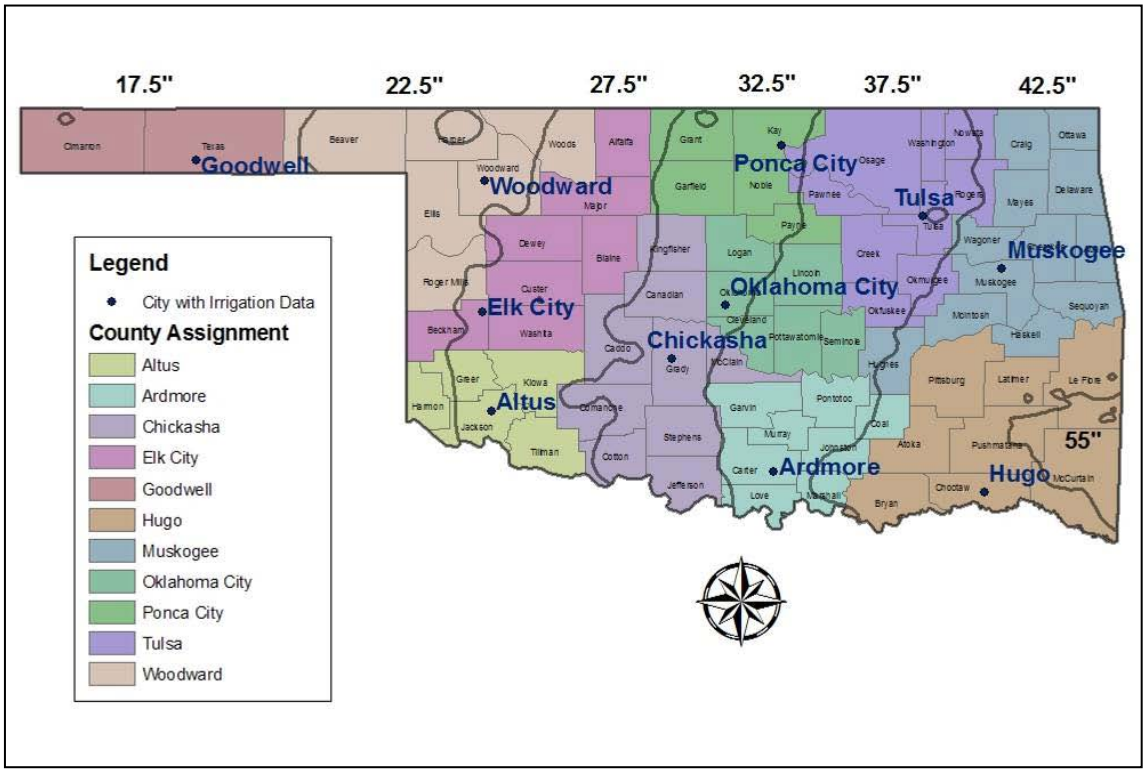

Figure 11 - Assignment of Irrigation Data to County Based on Average Annual Precipitation

Once the irrigated crop and water requirement data were collected and processed, the WCIR was calculated for each county, as shown in Table 21. The WCIR captures annual water demands for irrigation considering the unique mix of crop type, crop irrigation requirements, and precipitation zone for each county. The estimated WCIRs range in value from 0.59 AF per acre in Washita County up to 1.82 AF per acre in Carter County. The WCIR for each county is assumed to remain constant in the future. That is, the mix of crops planted and irrigated, as well as the water required for these plants, is assumed to remain the same in future years for each county as it is in the base year.

Table 21 - Weighted Crop Irrigation Requirement By County In Total AFY Acre-Feet Per Irrigated Acre

County	WCIR (AF/Acre)	County	WCIR (AF/Acre)	County	WCIR (AF/Acre)
Adair	1.26	Grant	1.04	Nowata	1.35
Alfalfa	1.59	Greer	1.31	Okfuskee	1.21
Atoka	1.32	Harmon	1.06	Oklahoma	1.59
Beaver	0.95	Harper	1.36	Okmulgee	1.17
Beckham	1.07	Haskell	1.26	Osage	0.96
Blaine	0.95	Hughes	1.13	Ottawa	1.33
Bryan	1.53	Jackson	1.20	Pawnee	1.68
Caddo	0.79	Jefferson	0.91	Payne	1.26
Canadian	1.35	Johnston	1.55	Pittsburg	1.39
Carter	1.82	Kay	1.11	Pontotoc	1.56
Cherokee	1.29	Kingfisher	1.20	Pottawatomie	1.14
Choctaw	1.31	Kiowa	1.29	Pushmataha	1.32
Cimarron	1.12	Latimer	1.35	Roger Mills	1.58
Cleveland	0.81	Le Flore	0.74	Rogers	1.54
Coal	1.15	Lincoln	1.39	Seminole	1.36
Comanche	1.54	Logan	1.06	Sequoyah	1.13
Cotton	1.41	Love	1.20	Stephens	1.45
Craig	1.28	Major	1.35	Texas	1.07
Creek	0.90	Marshall	1.75	Tillman	1.15
Custer	0.96	Mayes	1.25	Tulsa	1.62
Delaware	1.29	McClain	1.45	Wagoner	1.36
Dewey	1.29	McCurtain	1.10	Washington	0.91
Ellis	1.47	McIntosh	1.01	Washita	0.59
Garfield	0.99	Murray	1.02	Woods	1.41
Garvin	1.20	Muskogee	0.91	Woodward	0.89
Grady	1.13	Noble	1.25		

Estimation of future water requirements for irrigation is based upon the projection of future irrigated acres within each county. Thus, estimates were developed to project the total number of irrigated acres by county through 2060. Historical levels of irrigated acres by county as reported in the Ag Census were reviewed. The maximum number of acres irrigated from 1987 to 2007 is assumed to represent the build-out irrigated acres in 2060. For a number of counties, irrigated acres were highest in 2007 in comparison to that time period thus resulting in "no growth" in the forecast. For these counties, the maximum from 1977 to 2007 was assumed instead of the 1987 to 2007 period. For a few counties, irrigated acres is currently at its highest, even since 1977. For these counties, no growth is assumed.

The number of irrigated acres per forecast year is interpolated from the 2007 current acreage to the 2060 build-out maximum using linear interpolation. Thus, crop irrigation demand will show a linear growth from 2007 to 2060. Projection of irrigated acres for each county through 2060 is shown in Table 22. Statewide, the estimated 2060 irrigated acreage is 22 percent more than the 2007 irrigated acreage.

Table 22 - Projection of Irrigated Acres by County

County	2007*	2010	2020	2030	2040	2050	2060**
Adair	672	718	873	1,027	1,181	1,300	1,490
Alfalfa	2,617	2,689	2,928	3,167	3,406	3,589	3,884
Atoka	743	787	932	1,077	1,222	1,333	1,512
Beaver	28,512	28,763	29,598	30,434	31,269	31,910	32,940
Beckham	6,895	6,895	6,895	6,895	6,895	6,895	6,895
Blaine	5,845	5,845	5,845	5,845	5,845	5,845	5,845
Bryan	9,492	9,528	9,647	9,766	9,886	9,977	10,124
Caddo	33,152	34,028	36,950	39,871	42,793	45,035	48,636
Canadian	3,954	3,996	4,134	4,273	4,412	4,518	4,689
Carter	1,276	1,281	1,297	1,314	1,330	1,343	1,363
Cherokee	972	986	1,033	1,080	1,127	1,163	1,221
Choctaw	527	556	651	747	842	915	1,033
Cimarron	45,513	46,800	51,091	55,383	59,674	62,967	68,256
Cleveland	1,139	1,202	1,410	1,619	1,827	1,987	2,244
Coal	469	470	471	473	475	477	479
Comanche	1,449	1,482	1,592	1,702	1,812	1,896	2,032
Cotton	331	350	414	478	541	590	669
Craig	0	98	424	749	1,075	1,325	1,727
Creek	319	331	371	411	451	482	531
Custer	4,137	4,161	4,241	4,321	4,400	4,462	4,560
Delaware	624	624	624	624	624	624	624
Dewey	3,129	3,129	3,129	3,129	3,129	3,129	3,129
Ellis	12,829	13,256	14,680	16,105	17,529	18,622	20,377
Garfield	5,359	5,359	5,359	5,359	5,359	5,359	5,359
Garvin	812	909	1,234	1,559	1,884	2,134	2,534
Grady	8,465	8,465	8,465	8,465	8,465	8,465	8,465
Grant	1,473	1,473	1,473	1,473	1,473	1,473	1,473
Greer	3,442	3,860	5,255	6,649	8,043	9,113	10,832
Harmon	17,805	17,955	18,455	18,955	19,454	19,838	20,454
Harper	6,206	6,331	6,748	7,165	7,582	7,902	8,416
Haskell	1,703	1,745	1,886	2,027	2,167	2,276	2,449
Hughes	2,244	2,479	3,262	4,045	4,829	5,430	6,395
Jackson	55,120	55,455	56,572	57,689	58,806	59,663	61,040
Jefferson	330	339	369	399	428	451	488
Johnston	692	760	989	1,217	1,445	1,621	1,902
Kay	3,569	3,569	3,569	3,569	3,569	3,569	3,569
Kingfisher	5,527	5,611	5,891	6,170	6,450	6,664	7,009
Kiowa	2,615	2,637	2,709	2,782	2,854	2,910	2,999
Latimer	439	533	847	1,161	1,474	1,715	2,102
Le Flore	9,398	9,398	9,398	9,398	9,398	9,398	9,398
Lincoln	2,191	2,191	2,191	2,191	2,191	2,191	2,191
Logan	1,600	1,600	1,600	1,600	1,600	1,600	1,600
Love	1,838	1,940	2,280	2,619	2,959	3,219	3,638
Major	8,169	8,177	8,205	8,233	8,261	8,282	8,316
Marshall	2,254	2,276	2,348	2,421	2,493	2,549	2,638
Mayes	791	813	886	960	1,033	1,090	1,180
McClain	1,674	1,683	1,713	1,742	1,772	1,794	1,831
McCurtain	421	500	762	1,025	1,287	1,489	1,812

Table 22 - Projection of Irrigated Acres by County

County	2007*	2010	2020	2030	2040	2050	2060**
McIntosh	572	572	574	575	576	577	579
Murray	0	36	156	276	397	489	637
Muskogee	8,154	8,154	8,154	8,154	8,154	8,154	8,154
Noble	833	833	833	833	833	833	833
Nowata	131	165	276	388	500	585	723
Okfuskee	1,282	1,322	1,455	1,588	1,721	1,823	1,987
Oklahoma	2,935	2,935	2,935	2,935	2,935	2,935	2,935
Okmulgee	860	860	860	860	860	860	860
Osage	435	476	611	746	881	984	1,151
Ottawa	287	300	342	384	426	458	510
Pawnee	37	44	67	90	114	131	160
Payne	898	899	903	906	910	913	917
Pittsburg	1,671	1,710	1,842	1,973	2,105	2,206	2,368
Pontotoc	788	916	1,341	1,767	2,192	2,519	3,043
Pottawatomie	1,403	1,477	1,723	1,968	2,214	2,403	2,706
Pushmataha	524	525	527	530	533	535	538
Roger Mills	4,605	4,607	4,615	4,622	4,630	4,636	4,645
Rogers	811	833	904	976	1,048	1,103	1,191
Seminole	782	831	993	1,155	1,317	1,441	1,641
Sequoyah	1,622	1,649	1,740	1,831	1,921	1,991	2,103
Stephens	1,194	1,312	1,703	2,095	2,487	2,788	3,271
Texas	156,026	156,340	157,386	158,431	159,477	160,280	161,569
Tillman	12,974	13,028	13,206	13,385	13,563	13,700	13,920
Tulsa	3,901	3,941	4,075	4,208	4,342	4,444	4,609
Wagoner	5,226	5,226	5,226	5,226	5,226	5,226	5,226
Washington	497	538	675	812	950	1,055	1,224
Washita	7,300	7,396	7,714	8,033	8,351	8,595	8,988
Woods	1,984	2,023	2,154	2,285	2,416	2,517	2,678
Woodward	7,565	7,565	7,565	7,565	7,565	7,565	7,565
State Total	534,030	540,542	562,250	583,958	605,666	622,325	649,081

*Data from 2007 Ag Census
**Represent reasonable maximum irrigated acres. Obtained from analysis of 1987 to 2007 Ag Census data
BOLD indicates 2060 value was obtained from analysis of 1977 to 2007 Ag Census dataset

A final step is taken to adjust the irrigation water demands to capture on-farm losses from irrigation distribution systems. These losses need to be considered when estimating total irrigation water withdrawals. In order to adjust preliminary irrigation water demands to account for these losses, a field application efficiency factor was applied as a function of irrigation methods (surface, sprinkler or drip irrigation), as described below.

Field application efficiencies were determined following an extensive literature review by OWRB and CDM. Due to recent improvements in irrigation efficiency over the past decade, sources were limited to the past decade. Surface irrigation efficiency is reported as high as 95 percent and as low as 35 percent. Sprinkler irrigation efficiency values were as high as 98 percent and as low as 60 percent, depending on the type of system used. Drip irrigation efficiencies ranged from 70 percent to 95 percent (Vickers, 2001; Washington State Department of Ecology, 2005). For the OCWP, data were extracted from the Oklahoma 2003 Farm and Ranch Irrigation Survey to determine ratios of irrigation types to overall farm acreage. These ratios were multiplied by nationwide average field application

efficiency values determined from the extensive literature search. Values assumed in the OCWP for the field application efficiency by irrigation method are shown in Table 23.

Table 23 - Field Application Efficiency by Irrigation Method

Irrigation Method	Field Application Efficiency
Surface Irrigation	64%
Sprinkler Irrigation	85%
Drip Irrigation	89%

The percentage of acres irrigated by each irrigation method by county was calculated from 2005 USGS data, as shown in Table 24. For counties without available data, values were assumed from adjacent counties. These percentages by irrigation method were weighted to determine an overall weighted field application efficiency for each county. The applicable weighted field application efficiencies (WFAE) were used to adjust the preliminary estimates of water demand for irrigation, as shown in Equation 8. The gross irrigation water requirement, or the amount of water to be withdrawn and applied to the irrigation scheme, was calculated as:

Table 24 - Irrigation Methods by County

County	Sprinkler	Drip	Surface	County	Sprinkler	Drip	Surface
Adair	100%	0%	0%	Le Flore	28%	0%	72%
Alfalfa	100%	0%	0%	Lincoln	100%	0%	0%
Atoka	100%	0%	0%	Logan	100%	0%	0%
Beaver	93%	0%	7%	Love	100%	0%	0%
Beckham	100%	0%	0%	Major	99%	0%	1%
Blaine	100%	0%	0%	Marshall	92%	8%	0%
Bryan	100%	0%	0%	Mayes	**100%**	**0%**	**0%**
Caddo	100%	0%	0%	McClain	99%	1%	0%
Canadian	99%	0%	1%	McCurtain	0%	0%	100%
Carter	100%	0%	0%	McIntosh	100%	0%	0%
Cherokee	100%	0%	0%	Murray	100%	0%	0%
Choctaw	100%	0%	0%	Muskogee	92%	0%	8%
Cimarron	98%	0%	2%	Noble	100%	0%	0%
Cleveland	93%	0%	7%	Nowata	100%	0%	0%
Coal	100%	0%	0%	Okfuskee	100%	0%	0%
Comanche	100%	0%	0%	Oklahoma	98%	0%	2%
Cotton	98%	2%	0%	Okmulgee	80%	0%	20%
Craig	**100%**	**0%**	**0%**	Osage	100%	0%	0%
Creek	100%	0%	0%	Ottawa	**100%**	**0%**	**0%**
Custer	95%	0%	5%	Pawnee	100%	0%	0%
Delaware	100%	0%	0%	Payne	100%	0%	0%
Dewey	100%	0%	0%	Pittsburg	92%	0%	8%
Ellis	99%	1%	0%	Pontotoc	96%	0%	4%
Garfield	22%	77%	1%	Pottawatomie	100%	0%	0%
Garvin	84%	0%	16%	Pushmataha	100%	0%	0%
Grady	100%	0%	0%	Roger Mills	69%	0%	31%
Grant	100%	0%	0%	Rogers	100%	0%	0%
Greer	93%	0%	7%	Seminole	100%	0%	0%
Harmon	38%	0%	62%	Sequoyah	68%	21%	11%
Harper	90%	0%	10%	Stephens	100%	0%	0%
Haskell	100%	0%	0%	Texas	95%	0%	5%
Hughes	100%	0%	0%	Tillman	87%	0%	13%
Jackson	6%	0%	93%	Tulsa	100%	0%	0%
Jefferson	85%	11%	4%	Wagoner	100%	0%	0%

Table 24 - Irrigation Methods by County

County	Sprinkler	Drip	Surface	County	Sprinkler	Drip	Surface
Johnston	79%	0%	21%	Washington	100%	0%	0%
Kay	97%	0%	3%	Washita	100%	0%	0%
Kingfisher	100%	0%	0%	Woods	100%	0%	0%
Kiowa	50%	0%	50%	Woodward	93%	1%	6%
Latimer	100%	0%	0%				

***Bold values indicate no data available so closest county data assigned**

$$\mathrm{GrossQ}_{c,y} = \mathrm{Q}_{c,y}/\mathrm{WFAE}_{c,b}$$ *Equation 8*

Where:

- $\mathrm{GrossQ}_{c,y}$ = Gross water requirement for irrigation in AF in county (c) in year (y)
- $\mathrm{Q}_{c,y}$ = Total crop irrigation requirements in AF in county (c) in year (y) (Equation 5)
- $\mathrm{WFAE}_{c,b}$= Weighted field application efficiency in county (c) in base year (b)

The gross irrigation water requirement thus includes the estimated crop irrigation water requirement plus water losses. The weighted field application efficiency for each county is assumed to remain constant over time. This assumption may produce over-estimate crop irrigation water requirements, with all else being equal, as future irrigation methods become more water efficient. This potential over-estimation of irrigation water demand could be compounded, or offset, by any number of possible future scenarios related to cropping patterns and irrigation requirements as indicated at the beginning of this section.

The above methodology was used to compute and aggregate crop irrigation water demands for each county. The results are shown in Table 25. The 2060 water demand estimate represents the maximum likely irrigation demand under base conditions and assumptions as outlined above. This estimated build-out demand of 907,891 AFY for crop irrigation water is 22 percent greater than the 2007 demand, as illustrated in Figure 12. The highest water demands for crop irrigation can occur in Texas, Jackson, and Cimarron Counties.

Table 25 - Gross Annual Water Demands from Crop Irrigation including Irrigation System Losses (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Adair	993	1,062	1,290	1,518	1,746	1,922	2,203
Alfalfa	4,909	5,043	5,492	5,940	6,389	6,733	7,285
Atoka	1,150	1,217	1,441	1,666	1,890	2,063	2,339
Beaver	32,357	32,642	33,590	34,538	35,486	36,214	37,383
Beckham	8,718	8,718	8,718	8,718	8,718	8,718	8,718
Blaine	6,517	6,517	6,517	6,517	6,517	6,517	6,517
Bryan	17,044	17,108	17,322	17,536	17,750	17,915	18,178
Caddo	30,829	31,644	34,361	37,078	39,794	41,879	45,228
Canadian	6,309	6,376	6,597	6,818	7,040	7,210	7,482
Carter	2,732	2,742	2,777	2,812	2,847	2,874	2,918
Cherokee	1,480	1,501	1,573	1,644	1,716	1,770	1,859
Choctaw	815	859	1,007	1,154	1,302	1,415	1,597
Cimarron	60,416	62,125	67,821	73,517	79,214	83,585	90,606

Table 25 - Gross Annual Water Demands from Crop Irrigation including Irrigation System Losses (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Cleveland	1,106	1,166	1,369	1,571	1,773	1,929	2,178
Coal	637	637	640	643	645	647	650
Comanche	2,630	2,690	2,890	3,089	3,289	3,442	3,688
Cotton	549	581	687	793	898	980	1,110
Craig	0	147	638	1,128	1,618	1,995	2,599
Creek	336	349	391	433	475	508	560
Custer	4,746	4,774	4,865	4,957	5,048	5,119	5,232
Delaware	949	949	949	949	949	949	949
Dewey	4,752	4,752	4,752	4,752	4,752	4,752	4,752
Ellis	22,201	22,940	25,405	27,870	30,334	32,225	35,263
Garfield	6,029	6,029	6,029	6,029	6,029	6,029	6,029
Garvin	1,197	1,340	1,819	2,298	2,777	3,144	3,734
Grady	11,291	11,291	11,291	11,291	11,291	11,291	11,291
Grant	1,801	1,801	1,801	1,801	1,801	1,801	1,801
Greer	5,407	6,064	8,255	10,445	12,636	14,317	17,016
Harmon	26,234	26,455	27,191	27,927	28,664	29,229	30,137
Harper	10,185	10,391	11,075	11,759	12,444	12,969	13,813
Haskell	2,526	2,589	2,798	3,006	3,215	3,375	3,633
Hughes	2,973	3,285	4,323	5,360	6,398	7,195	8,474
Jackson	101,101	101,716	103,765	105,813	107,862	109,434	111,960
Jefferson	354	363	395	427	459	484	523
Johnston	1,333	1,464	1,904	2,344	2,783	3,121	3,662
Kay	4,690	4,690	4,690	4,690	4,690	4,690	4,690
Kingfisher	7,808	7,926	8,321	8,716	9,111	9,415	9,902
Kiowa	4,525	4,563	4,688	4,813	4,939	5,035	5,190
Latimer	698	848	1,347	1,846	2,346	2,729	3,344
Le Flore	9,985	9,985	9,985	9,985	9,985	9,985	9,985
Lincoln	3,575	3,575	3,575	3,575	3,575	3,575	3,575
Logan	1,991	1,991	1,991	1,991	1,991	1,991	1,991
Love	2,593	2,737	3,216	3,695	4,174	4,542	5,133
Major	13,020	13,033	13,078	13,122	13,166	13,200	13,254
Marshall	4,611	4,655	4,804	4,952	5,100	5,214	5,397
Mayes	1,163	1,196	1,303	1,411	1,519	1,602	1,735
McClain	2,853	2,868	2,918	2,969	3,019	3,058	3,120
McCurtain	721	856	1,306	1,756	2,205	2,550	3,105
McIntosh	682	682	684	685	687	688	690
Murray	0	43	188	332	476	587	765
Muskogee	8,882	8,882	8,882	8,882	8,882	8,882	8,882
Noble	1,223	1,223	1,223	1,223	1,223	1,223	1,223
Nowata	208	261	438	616	793	929	1,148
Okfuskee	1,830	1,887	2,077	2,267	2,457	2,602	2,836
Oklahoma	5,537	5,537	5,537	5,537	5,537	5,537	5,537
Okmulgee	1,250	1,250	1,250	1,250	1,250	1,250	1,250
Osage	492	538	691	843	996	1,113	1,302
Ottawa	447	467	533	598	664	714	795
Pawnee	73	87	133	179	225	260	317
Payne	1,332	1,333	1,339	1,344	1,349	1,353	1,360
Pittsburg	2,793	2,859	3,079	3,299	3,519	3,687	3,958
Pontotoc	1,465	1,702	2,493	3,284	4,075	4,682	5,657
Pottawatomie	1,881	1,980	2,309	2,639	2,969	3,222	3,628
Pushmataha	814	816	820	824	828	831	836
Roger Mills	9,262	9,266	9,281	9,296	9,312	9,323	9,342
Rogers	1,470	1,509	1,639	1,769	1,900	1,999	2,160
Seminole	1,250	1,328	1,587	1,847	2,106	2,305	2,624
Sequoyah	2,184	2,221	2,343	2,465	2,587	2,681	2,832

Table 25 - Gross Annual Water Demands from Crop Irrigation including Irrigation System Losses (AFY)

County	2007	2010	2020	2030	2040	2050	2060
Stephens	2,031	2,231	2,898	3,564	4,231	4,742	5,564
Texas	199,312	199,713	201,049	202,385	203,721	204,747	206,393
Tillman	18,089	18,163	18,412	18,661	18,910	19,101	19,408
Tulsa	7,427	7,503	7,757	8,012	8,266	8,461	8,775
Wagoner	8,392	8,392	8,392	8,392	8,392	8,392	8,392
Washington	530	574	721	867	1,014	1,126	1,306
Washita	5,063	5,130	5,350	5,571	5,792	5,962	6,234
Woods	3,288	3,353	3,570	3,787	4,005	4,171	4,439
Woodward	8,026	8,026	8,026	8,026	8,026	8,026	8,026
State Total	736,074	745,210	775,661	806,112	836,562	859,932	897,464

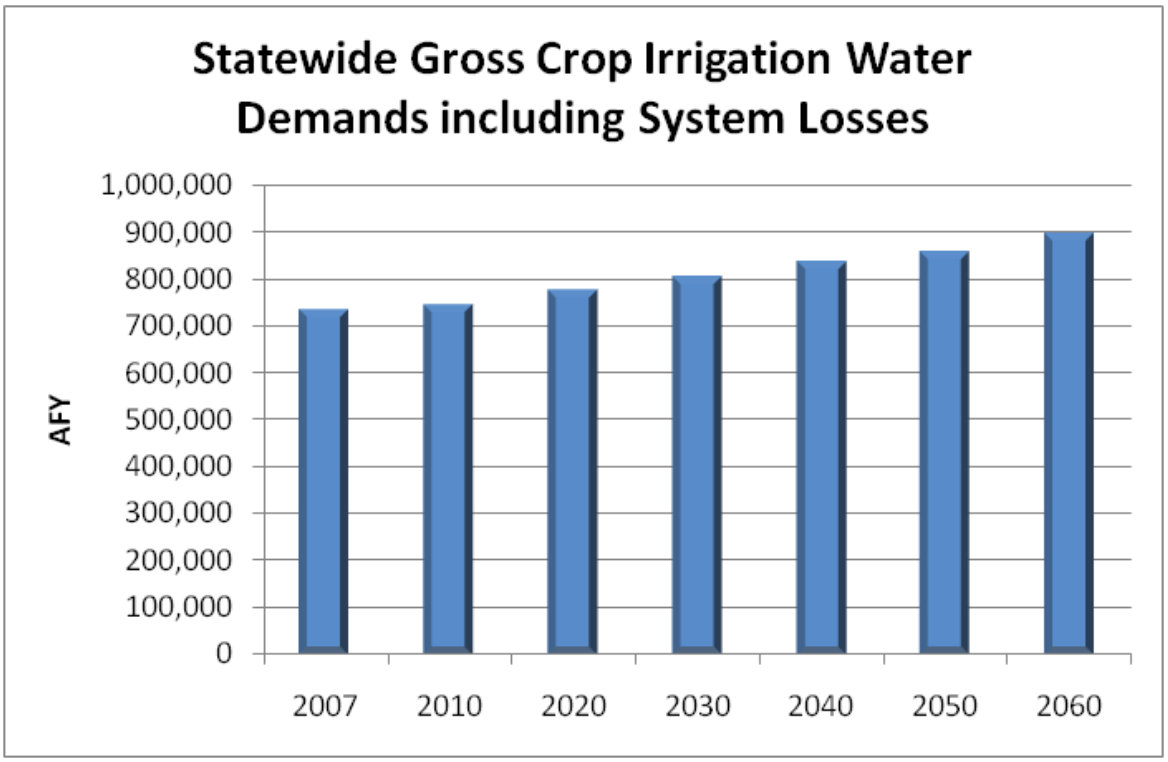

Figure 12 - Statewide Gross Crop Irrigation Water Demands including System Losses

5.3 Combined Agricultural Water Demands

Table 26 shows the aggregated livestock and crop irrigation water demands by county. Under the base conditions and assumptions outlined herein, agriculture demands are estimated to increase by 20.3 percent to a maximum estimated 2060 volume of nearly 1 million AFY. Livestock and crop irrigation requirements constitute 10 and 90 percent of the total demand, respectively, as shown in Figure 13. The proportion of livestock to crop irrigation water demand is not estimated to change over the planning period.

Table 26 - Total Agriculture Water Demands including Crop Irrigation and Livestock Requirements

County	2007	2010	2020	2030	2040	2050	2060
Adair	2,424	2,503	2,766	3,029	3,292	3,502	3,818
Alfalfa	6,184	6,330	6,818	7,305	7,792	8,175	8,767
Atoka	2,266	2,333	2,558	2,783	3,008	3,180	3,457
Beaver	35,409	35,709	36,710	37,710	38,710	39,490	40,711
Beckham	9,480	9,488	9,513	9,538	9,564	9,589	9,615
Blaine	8,082	8,082	8,080	8,078	8,077	8,075	8,073
Bryan	18,606	18,671	18,889	19,107	19,325	19,493	19,761
Caddo	33,110	33,925	36,642	39,359	42,076	44,161	47,509
Canadian	7,815	7,886	8,122	8,359	8,596	8,781	9,069
Carter	3,505	3,521	3,574	3,627	3,679	3,724	3,785
Cherokee	2,308	2,330	2,402	2,474	2,547	2,602	2,691
Choctaw	1,824	1,869	2,018	2,168	2,317	2,432	2,615
Cimarron	62,313	64,032	69,762	75,491	81,221	85,626	92,681
Cleveland	1,523	1,588	1,801	2,015	2,229	2,396	2,657
Coal	1,226	1,234	1,259	1,285	1,311	1,335	1,362
Comanche	3,632	3,698	3,918	4,139	4,359	4,532	4,799
Cotton	1,489	1,523	1,637	1,750	1,863	1,952	2,089
Craig	1,683	1,831	2,327	2,822	3,317	3,698	4,307
Creek	986	1,003	1,060	1,116	1,173	1,220	1,286
Custer	5,988	6,028	6,160	6,292	6,423	6,534	6,687
Delaware	3,243	3,260	3,317	3,375	3,432	3,490	3,547
Dewey	5,456	5,465	5,494	5,522	5,551	5,580	5,609
Ellis	23,578	24,321	26,798	29,274	31,751	33,654	36,704
Garfield	7,388	7,390	7,397	7,405	7,412	7,419	7,427
Garvin	2,391	2,537	3,022	3,507	3,992	4,366	4,963
Grady	13,449	13,473	13,550	13,627	13,705	13,782	13,859
Grant	2,481	2,490	2,521	2,552	2,583	2,614	2,645
Greer	5,849	6,506	8,697	10,888	13,079	14,761	17,461
Harmon	26,795	27,020	27,768	28,517	29,265	29,843	30,762
Harper	11,624	11,832	12,523	13,215	13,907	14,439	15,290
Haskell	3,689	3,755	3,976	4,197	4,418	4,591	4,860
Hughes	4,622	4,939	5,995	7,051	8,107	8,921	10,219
Jackson	101,677	102,308	104,411	106,514	108,617	110,244	112,823
Jefferson	1,650	1,660	1,697	1,733	1,769	1,798	1,841
Johnston	1,952	2,086	2,535	2,983	3,432	3,778	4,329
Kay	5,303	5,308	5,325	5,343	5,360	5,378	5,395
Kingfisher	10,001	10,124	10,536	10,948	11,360	11,680	12,183
Kiowa	5,605	5,645	5,780	5,914	6,049	6,155	6,318
Latimer	1,268	1,419	1,923	2,426	2,930	3,317	3,937
Le Flore	12,479	12,485	12,502	12,520	12,538	12,556	12,574
Lincoln	4,692	4,693	4,694	4,696	4,697	4,699	4,700
Logan	2,719	2,733	2,780	2,827	2,874	2,922	2,969
Love	3,248	3,392	3,871	4,350	4,829	5,197	5,788
Major	14,957	14,977	15,045	15,112	15,179	15,236	15,314
Marshall	4,918	4,967	5,131	5,295	5,460	5,589	5,788
Mayes	2,651	2,686	2,804	2,921	3,038	3,131	3,273
McClain	3,763	3,780	3,837	3,895	3,952	3,998	4,067
McCurtain	2,756	2,912	3,429	3,947	4,464	4,878	5,500
McIntosh	1,518	1,526	1,552	1,577	1,603	1,627	1,653
Murray	392	444	618	793	968	1,108	1,317
Muskogee	10,020	10,022	10,028	10,035	10,041	10,048	10,055
Noble	2,096	2,097	2,099	2,101	2,103	2,105	2,107
Nowata	1,317	1,370	1,546	1,723	1,899	2,034	2,252
Okfuskee	2,556	2,615	2,813	3,011	3,208	3,362	3,604
Oklahoma	5,907	5,908	5,911	5,914	5,917	5,920	5,923
Okmulgee	1,994	1,994	1,997	2,000	2,003	2,006	2,009

Table 26 - Total Agriculture Water Demands including Crop Irrigation and Livestock Requirements

County	2007	2010	2020	2030	2040	2050	2060
Osage	2,809	2,861	3,034	3,207	3,380	3,517	3,726
Ottawa	1,498	1,522	1,604	1,684	1,766	1,832	1,928
Pawnee	689	703	750	797	844	881	939
Payne	2,160	2,164	2,178	2,192	2,206	2,219	2,234
Pittsburg	3,970	4,040	4,273	4,506	4,740	4,922	5,207
Pontotoc	2,313	2,555	3,362	4,170	4,977	5,601	6,592
Pottawatomie	2,827	2,927	3,260	3,593	3,926	4,182	4,592
Pushmataha	1,307	1,310	1,322	1,334	1,345	1,356	1,369
Roger Mills	10,125	10,137	10,177	10,217	10,257	10,294	10,338
Rogers	2,587	2,628	2,766	2,904	3,042	3,149	3,317
Seminole	1,873	1,955	2,229	2,503	2,777	2,990	3,324
Sequoyah	2,905	2,950	3,101	3,252	3,403	3,526	3,705
Stephens	3,043	3,250	3,941	4,632	5,324	5,860	6,706
Texas	208,445	208,874	210,303	211,732	213,161	214,280	216,020
Tillman	18,976	19,053	19,307	19,561	19,815	20,012	20,324
Tulsa	7,763	7,841	8,099	8,357	8,615	8,813	9,130
Wagoner	9,031	9,032	9,034	9,037	9,039	9,041	9,044
Washington	1,065	1,110	1,259	1,409	1,558	1,673	1,856
Washita	6,574	6,640	6,861	7,081	7,302	7,471	7,743
Woods	4,628	4,701	4,945	5,189	5,433	5,626	5,920
Woodward	9,881	9,881	9,882	9,882	9,883	9,883	9,884
State Total	830,329	839,859	871,628	903,395	935,164	959,849	998,698

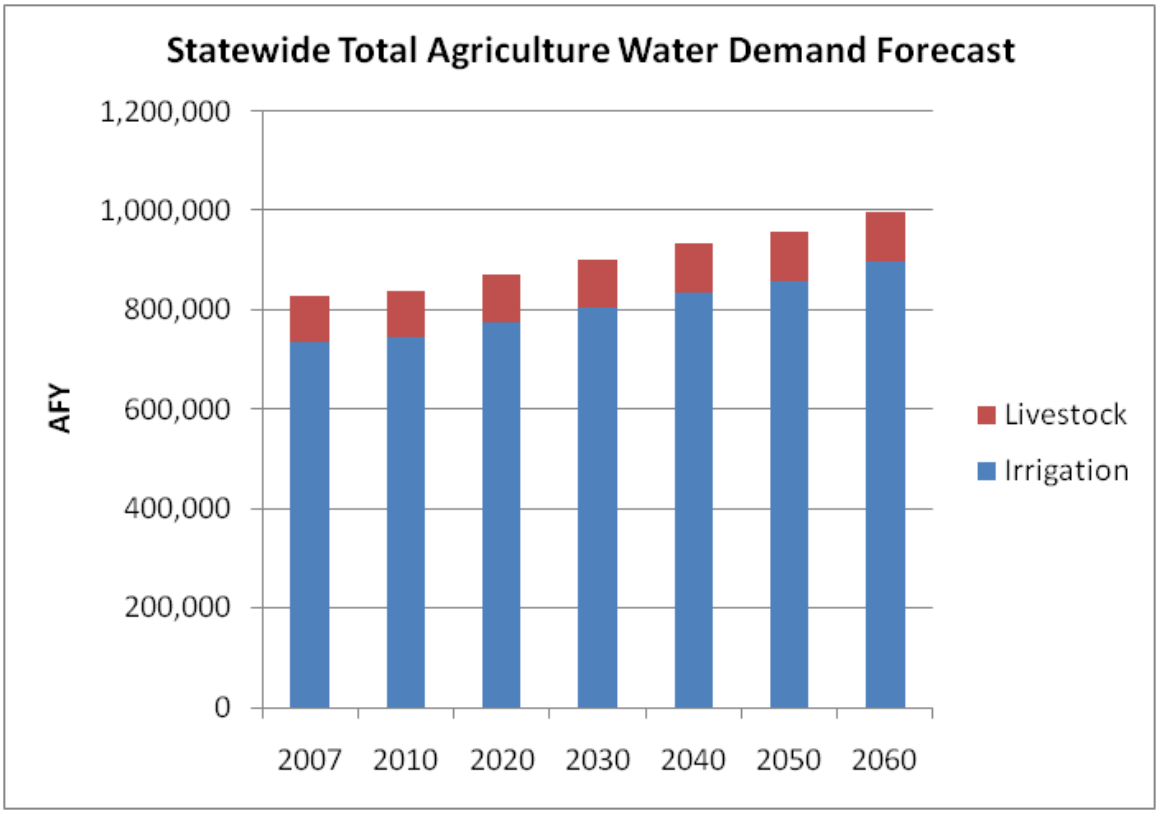

Figure 13 - Statewide Total Agriculture Water Demand Forecast

Section 6
Summary

6.1 Forecast Assumptions

The county-level water demand forecasts presented in this report are contingent upon a number of assumptions. These assumptions include the following:

- Population by county will increase to 2060 as projected by ODOC.
- Residential water use in each county will maintain the current average rate of water use per capita.
- Self-supplied residential water use is the same per capita rate of use as publically-supplied residential users within the same county.
- The ratio of self-served population to system-served population will remain constant at current levels for each county.
- State-wide employment will increase to 2016 as projected by OESC, and as extrapolated to 2060.
- Future county employment growth will maintain the current proportion by NAICS classifications.
- Water use per employee will maintain the current average rate of use per employee per NAICS group.
- System losses among public and rural water district systems will maintain the current average rate of loss per county, and not exceed 15 percent real system loss.
- Average water use per well for oil and gas drilling is expected to increase over time. All future oil and gas wells will be in counties where present wells are located.
- Water use for thermoelectric power generation will maintain the current average water use per MWh.
- Power generation per county will increase to 2060 at a rate of 1.1 percent annually. All future power production will be in counties with present power facilities, except where noted.
- Water use among significant large users will increase from the current rate of use at the rate of growth for the corresponding NAICS employment group in the respective county.
- Water use for livestock will remain at current levels per animal.
- Water use per crop type will remain at current levels per acre.

- Water use efficiency and irrigation type by county will remain at current levels.
- Future weather conditions will be similar to conditions associated with current rates of water use.
- The rates of water use per unit for each sector do not account for future improvements in water use efficiency (i.e., water conservation) beyond current levels.

6.2 Forecast by County for the State

Table 27 summarizes statewide demands by sector and Table 28 summarizes all sector demands by county through the forecast period. Total water demand is projected to increase from nearly 1.8 million AFY in 2007 to over 2.4 million AFY in 2060. In the base year, crop irrigation accounts for nearly half (41 percent) of total water demand and M&I Public-Supply accounts for 33 percent of total water demand. The percentages remain relatively the same throughout the forecast period. The demands in the summary tables include system losses from the public-supply sectors and include total withdrawals for thermoelectric power generation.

Table 27 - Summary of Sector Demands, Statewide (AFY)

SECTOR	2007	2010	2020	2030	2040	2050	2060
M&I Public-Supply*	583,901	601,891	647,038	682,391	713,982	743,158	772,773
Self-Supplied Residential	29,524	30,217	32,610	34,770	36,863	38,978	41,155
Self-Supplied Industrial	89,942	88,780	87,558	92,313	96,730	101,258	105,683
Thermoelectric Power**	252,127	260,539	290,660	324,262	361,750	403,571	450,227
Livestock	94,087	94,480	95,792	97,104	98,416	99,728	101,040
Irrigation	736,074	745,210	775,661	806,112	836,562	859,932	897,464
Oil and Gas Activities	29,107	42,107	74,403	78,202	90,080	102,536	115,570
Total All Sectors	1,814,763	1,863,224	2,003,721	2,115,154	2,234,382	2,349,161	2,483,912

*Including system losses
**Total withdrawals

Table 28 - Summary of Water Demands by County, All Sectors (AFY)*

County	2007	2010	2020	2030	2040	2050	2060
Adair	5,465	5,844	7,038	7,401	7,904	8,291	8,709
Alfalfa	7,323	7,536	8,192	8,884	9,620	10,314	11,262
Atoka	5,726	5,920	6,556	7,218	7,879	8,534	9,294
Beaver	37,314	37,846	39,173	40,524	41,923	43,149	44,865
Beckham	14,744	15,044	15,685	16,425	17,202	18,018	18,918
Blaine	11,212	11,352	11,677	12,081	12,502	12,940	13,418
Bryan	26,824	27,209	28,271	29,395	30,519	31,596	32,794
Caddo	43,178	44,399	48,167	51,975	55,901	59,322	64,128
Canadian	27,622	29,394	34,610	34,329	34,746	34,634	34,247
Carter	14,668	15,905	19,542	18,278	17,750	16,850	15,602

Table 28 - Summary of Water Demands by County, All Sectors (AFY)*

County	2007	2010	2020	2030	2040	2050	2060
Cherokee	9,601	9,988	11,059	12,238	13,432	14,579	15,790
Choctaw	10,827	11,155	12,238	13,368	14,620	15,954	17,493
Cimarron	63,338	65,080	70,895	76,683	82,445	86,916	94,040
Cleveland	39,261	40,675	43,889	46,510	48,670	50,238	51,879
Coal	3,186	3,763	5,521	4,687	4,267	3,644	2,808
Comanche	21,864	23,548	25,246	26,726	28,045	29,213	30,424
Cotton	2,263	2,316	2,459	2,589	2,719	2,837	2,993
Craig	3,994	4,225	4,951	5,699	6,477	7,142	8,052
Creek	9,867	10,161	10,875	11,506	12,124	12,745	13,435
Custer	12,025	12,357	13,025	13,693	14,410	15,090	15,840
Delaware	8,224	8,481	9,245	10,051	10,881	11,770	12,694
Dewey	7,069	7,172	7,324	7,518	7,741	8,025	8,337
Ellis	25,103	26,099	29,300	32,744	36,391	39,721	44,456
Garfield	19,744	20,018	20,610	21,045	21,478	21,867	22,317
Garvin	8,137	8,496	9,358	10,186	11,051	11,862	12,932
Grady	20,262	20,691	21,547	22,432	23,343	24,320	25,375
Grant	3,415	3,496	3,676	3,883	4,106	4,392	4,696
Greer	6,881	7,548	9,754	11,947	14,159	15,861	18,582
Harmon	27,569	27,812	28,569	29,343	30,117	30,720	31,665
Harper	13,112	13,416	14,311	15,238	16,210	17,105	18,326
Haskell	6,114	6,625	8,193	10,174	12,535	15,217	18,391
Hughes	8,620	9,997	14,207	13,700	13,935	13,564	13,286
Jackson	106,924	107,669	110,075	112,482	114,846	116,708	119,498
Jefferson	2,457	2,484	2,553	2,617	2,683	2,756	2,845
Johnston	5,183	5,378	6,097	6,961	7,867	8,749	9,893
Kay	24,155	24,705	25,684	26,285	26,856	27,436	28,065
Kingfisher	13,528	13,821	14,663	15,597	16,550	17,433	18,564
Kiowa	6,877	6,946	7,129	7,300	7,474	7,635	7,857
Latimer	4,038	4,393	5,276	6,216	7,232	8,185	9,445
Le Flore	25,779	26,477	28,716	31,365	34,439	37,947	41,929
Lincoln	8,684	8,953	9,685	10,505	11,459	12,549	13,783
Logan	10,425	10,794	11,882	13,149	14,505	15,932	17,506
Love	4,753	4,987	9,142	9,961	10,801	11,551	12,526
Major	16,591	16,802	17,156	17,522	17,949	18,410	18,936
Marshall	7,406	7,719	9,676	10,312	11,064	11,765	12,518
Mayes	12,392	12,736	13,855	15,082	16,402	17,787	19,319
McClain	14,974	15,487	17,122	18,889	20,771	22,799	25,006
McCurtain	43,372	42,973	42,973	44,961	46,758	48,570	50,506
McIntosh	4,143	4,450	5,380	6,544	7,946	9,597	11,474
Murray	3,043	3,192	3,609	4,074	4,521	4,975	5,499
Muskogee	142,794	145,950	157,906	172,310	188,144	205,719	225,234
Noble	4,111	4,270	4,544	4,807	5,102	5,416	5,763
Nowata	2,723	2,935	3,403	3,912	4,443	4,966	5,603
Okfuskee	4,210	4,370	4,782	5,219	5,698	6,174	6,792
Oklahoma	137,389	141,512	150,167	157,097	162,877	167,742	172,792
Okmulgee	12,816	13,118	13,998	14,811	15,670	16,573	17,496
Osage	12,451	12,846	13,833	14,722	15,601	16,474	17,507
Ottawa	7,203	7,400	7,925	8,396	8,900	9,407	9,944
Pawnee	40,252	41,604	46,380	51,661	57,534	64,055	71,313
Payne	15,167	15,761	16,935	18,195	19,474	20,477	21,484
Pittsburg	31,008	34,277	44,287	41,846	41,605	40,553	38,853
Pontotoc	8,941	9,388	10,608	11,763	12,937	13,928	15,305
Pottawatomie	10,835	11,225	12,322	13,547	14,839	16,134	17,695
Pushmataha	2,476	2,527	2,679	2,842	3,015	3,206	3,400
Roger Mills	11,576	11,899	12,419	13,028	13,734	14,532	15,433
Rogers	39,070	40,432	44,922	49,708	54,771	60,261	66,312

Table 28 - Summary of Water Demands by County, All Sectors (AFY)*

County	2007	2010	2020	2030	2040	2050	2060
Seminole	22,457	23,316	26,108	29,185	32,619	36,393	40,710
Sequoyah	11,910	12,198	13,109	14,191	15,255	16,315	17,434
Stephens	12,848	13,360	14,586	15,737	16,971	18,155	19,755
Texas	223,906	224,653	227,314	232,447	237,694	242,743	248,480
Tillman	20,415	20,518	20,852	21,183	21,524	21,818	22,254
Tulsa	128,952	132,440	140,864	148,011	153,893	159,107	164,638
Wagoner	21,800	22,285	23,844	25,371	26,928	28,574	30,369
Washington	13,046	13,389	14,088	14,503	14,987	15,456	16,037
Washita	8,354	8,717	9,729	10,947	12,380	13,998	15,934
Woods	8,466	8,726	9,205	9,733	10,297	10,849	11,577
Woodward	20,310	20,568	21,076	21,697	22,264	22,923	23,579
Grand Total	1,814,763	1,863,224	2,003,721	2,115,154	2,234,382	2,349,161	2,483,912

*Including system losses for M&I Public-Supply and total withdrawals for Thermoelectric Power

Section 7
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Appendices

Appendix A
Data Log

Data	Description	Source
Bureau of Labor Statistics (BLS) QCEW	County level employment data for 2006	http://www.bls.gov/cew/
Census 2007 Estimates	Estimates of population for 2007	http://www.census.gov/
Chickasaw Nation Report	Supplemental population and employment data	
Department of Energy (DOE) Energy Information Administration (EIA) From 906	Thermoelectric facility information	http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=OK#related_reports
Ft. Sill Base Realignment data	Future numbers of soldiers and civilians employed at Ft. Sill	Steve Hankins DPW/OMD Ft. Sill, Ok. 73503 Office: 580-442-3608
IWR-MAIN software	Per employee water use factors developed from non-residential database	CDM
Natural Resource Conservation Service (NRCS) Irrigation Guide Report, Oklahoma Supplement	Provides technical information and procedures that can be used for successful planning, design, and management of irrigation systems	http://www.wsi.nrcs.usda.gov/products/w2q/water_mgt/Irrigation/irrig-handbooks.html
Oklahoma Department of Commerce (ODOC)	Population projections by City by County, special run of extra years completed in November 2002	www.okcommerce.gov
Oklahoma Department of Environmental Quality (ODEQ) Safe Drinking Water Information System (SDWIS) database	Public water supplier information	OWRB
Oklahoma Employment Security Commission (OESC)	10-year projections of state-wide employment by 2- and 3-digit NAICS	http://www.oesc.state.ok.us/lmi/
Oklahoma Office of the Secretary of Energy	Thermoelectric facility information	http://energy.ok.gov/general.asp?id=174

Data	Description	Source
OWRB Water Rights Database	Large Industry data, oil and gas permitting data,	OWRB
Provider Survey	Used to develop the public-supply residential, public-supply nonresidential, and the self-supplied residential forecast	CDM / OWRB
U.S. Environmental Protection Agency eGrid	Thermoelectric facility information	http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html
U.S. Geological Survey Preliminary Water Use Reports for 2005	Used to split the population projections into public supplied and self-supplied, used source water for irrigation, used irrigation methods by county	Bob Tortorelli at USGS, Office: 405-810-4404
U .S.Geological Survey, 2005, *Method for Estimating Water Withdrawals for Livestock in the United States, Scientific Investigations Report 2009-5041*	Water per day requirements for livestock	Downloadable at: http://pubs.usgs.gov/sir/2009/5041/
USDA's National Agricultural Statistics Service (NASS)	County level agricultural data	http://www.nass.usda.gov/Data_and_Statistics/index.asp
Department of Energy (DOE) Energy Information Administration (EIA) Annual Energy Outlook (AEO) Report	Projection of future electricity production	www.eia.doe.gov/oiaf/aeo/pdf/earlyrelease.pdf
Energy Development Water Needs Assessment, Draft Report, prepared for Colorado and Yampa/White Rivers Roundtable Committees by URS	Thermoelectric power consumption and withdrawal rates	

Appendix B
County Demands and Supporting Data

Adair	2007	2010	2020	2030	2040	2050	2060
Population, Total	21,902	22,962	26,773	30,585	34,396	38,301	42,205
Public-Supplied Population	12,762	13,380	15,600	17,821	20,042	22,317	24,592
Self-Supplied Population	9,140	9,582	11,173	12,763	14,354	15,983	17,613
Employment, Total	5,376	5,537	5,864	6,699	7,533	8,389	9,244
11 Agriculture, forestry, fishing and hunting	31	31	33	37	42	47	51
21 Mining, quarrying, and oil and gas extraction	12	12	13	15	16	18	20
22 Utilities	75	77	81	92	104	116	127
23 Construction	208	222	245	280	315	350	386
31-33 Manufacturing	1,525	1,495	1,472	1,682	1,891	2,106	2,321
42 Wholesale trade	76	78	82	94	106	118	130
44-45 Retail trade	549	560	586	670	753	839	924
48-49 Transportation and warehousing	156	161	171	196	220	245	270
51 Information	27	28	30	34	38	42	47
52 Finance and insurance	123	126	134	153	172	191	211
53 Real estate and rental and leasing	16	17	18	21	24	26	29
54 Professional and technical services	54	59	68	77	87	97	107
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	514	553	622	711	799	890	981
61 Educational services	882	924	1,001	1,143	1,286	1,432	1,578
62 Health care and social assistance	453	482	534	610	686	764	842
71 Arts, entertainment, and recreation	75	83	96	110	124	138	152
72 Accommodation and food services	243	257	282	322	362	404	445
81 Other services, except public administration	61	63	67	77	87	96	106
92 Public Administration	293	304	326	372	419	466	514
99 Unclassified	2	2	2	2	3	3	3
Public-Supply Nonresidential Including System Losses (AFY)	765	785	827	945	1,063	1,183	1,304
Public-Supply Residential Including System Losses (AFY)	1,153	1,209	1,409	1,610	1,811	2,016	2,222
Self-Supply Residential (AFY)	702	736	858	980	1,102	1,227	1,353
Projection of Irrigated Lands (in Acres)	672	718	873	1,027	1,181	1,300	1,490
Crop Irrigation (AFY)	993	1,062	1,290	1,518	1,746	1,922	2,203
Livestock (AFY)	1,431	1,441	1,476	1,511	1,546	1,581	1,616
Oil and Gas Drilling (AFY)	420	610	1,177	836	636	361	12
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**5,465**	**5,844**	**7,038**	**7,401**	**7,904**	**8,291**	**8,709**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Alfalfa	2007	2010	2020	2030	2040	2050	2060
Population, Total	5,593	5,537	5,537	5,537	5,537	5,631	5,724
Public-Supplied Population	4,733	4,685	4,685	4,685	4,685	4,765	4,844
Self-Supplied Population	860	851	851	851	851	866	880
Employment, Total	1,237	1,286	1,359	1,359	1,359	1,382	1,405
11 Agriculture, forestry, fishing and hunting	14	14	15	15	15	15	15
21 Mining, quarrying, and oil and gas extraction	35	37	38	38	38	39	39
22 Utilities	24	25	26	26	26	26	27
23 Construction	52	55	60	60	60	61	62
31-33 Manufacturing	30	29	29	29	29	29	29
42 Wholesale trade	132	135	141	141	141	143	146
44-45 Retail trade	137	140	144	144	144	147	149
48-49 Transportation and warehousing	61	63	66	66	66	68	69
51 Information	10	10	11	11	11	11	11
52 Finance and insurance	62	64	67	67	67	68	69
53 Real estate and rental and leasing	5	6	6	6	6	6	6
54 Professional and technical services	41	45	51	51	51	52	53
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	8	9	10	10	10	10	10
61 Educational services	180	189	201	201	201	205	208
62 Health care and social assistance	106	113	123	123	123	125	127
71 Arts, entertainment, and recreation	0	0	0	0	0	0	0
72 Accommodation and food services	48	51	55	55	55	56	57
81 Other services, except public administration	33	34	36	36	36	37	37
92 Public Administration	254	264	278	278	278	283	288
99 Unclassified	2	2	2	2	2	2	2
Public-Supply Nonresidential Including System Losses (AFY)	160	167	176	176	176	179	182
Public-Supply Residential Including System Losses (AFY)	713	706	706	706	706	718	730
Self-Supply Residential (AFY)	117	115	115	115	115	117	119
Projection of Irrigated Lands (in Acres)	2,617	2,689	2,928	3,167	3,406	3,589	3,884
Crop Irrigation (AFY)	4,909	5,043	5,492	5,940	6,389	6,733	7,285
Livestock (AFY)	1,275	1,287	1,325	1,363	1,402	1,440	1,478
Oil and Gas Drilling (AFY)	149	218	378	583	833	1,128	1,468
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**7,323**	**7,536**	**8,192**	**8,884**	**9,620**	**10,314**	**11,262**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Atoka	2007	2010	2020	2030	2040	2050	2060
Population, Total	14,512	15,036	16,879	18,722	20,565	22,602	24,639
Public-Supplied Population	11,482	11,896	13,355	14,813	16,271	17,883	19,495
Self-Supplied Population	3,030	3,139	3,524	3,909	4,294	4,719	5,145
Employment, Total	3,368	3,497	3,730	4,138	4,545	4,995	5,445
11 Agriculture, forestry, fishing and hunting	7	7	7	8	8	9	10
21 Mining, quarrying, and oil and gas extraction	25	25	27	30	33	36	39
22 Utilities	34	35	36	40	44	48	53
23 Construction	84	89	98	109	120	132	143
31-33 Manufacturing	329	323	316	351	385	423	462
42 Wholesale trade	36	37	39	43	47	52	57
44-45 Retail trade	443	453	471	523	574	631	688
48-49 Transportation and warehousing	112	116	123	136	150	164	179
51 Information	41	42	44	49	53	59	64
52 Finance and insurance	99	102	107	119	131	143	156
53 Real estate and rental and leasing	17	18	20	22	24	26	28
54 Professional and technical services	33	36	41	46	50	55	60
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	14	15	17	19	21	23	25
61 Educational services	410	429	463	513	564	620	676
62 Health care and social assistance	658	701	773	857	941	1,035	1,128
71 Arts, entertainment, and recreation	29	33	38	42	46	51	55
72 Accommodation and food services	155	164	179	198	218	239	261
81 Other services, except public administration	137	142	151	167	184	202	220
92 Public Administration	704	731	780	865	950	1,044	1,138
99 Unclassified	2	2	2	2	2	3	3
Public-Supply Nonresidential Including System Losses (AFY)	493	512	546	606	665	731	797
Public-Supply Residential Including System Losses (AFY)	2,424	2,512	2,820	3,128	3,436	3,776	4,116
Self-Supply Residential (AFY)	544	563	632	702	771	847	923
Projection of Irrigated Lands (in Acres)	743	787	932	1,077	1,222	1,333	1,512
Crop Irrigation (AFY)	1,150	1,217	1,441	1,666	1,890	2,063	2,339
Livestock (AFY)	1,116	1,116	1,117	1,117	1,117	1,118	1,118
Oil and Gas Drilling (AFY)	0	0	0	0	0	0	0
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**5,726**	**5,920**	**6,556**	**7,218**	**7,879**	**8,534**	**9,294**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Beaver	2007	2010	2020	2030	2040	2050	2060
Population, Total	5,380	5,435	5,527	5,620	5,712	5,804	5,896
Public-Supplied Population	2,760	2,788	2,836	2,883	2,930	2,977	3,025
Self-Supplied Population	2,620	2,647	2,692	2,737	2,782	2,826	2,871
Employment, Total	1,425	1,484	1,579	1,605	1,631	1,658	1,684
11 Agriculture, forestry, fishing and hunting	86	87	89	91	92	94	95
21 Mining, quarrying, and oil and gas extraction	224	231	242	246	250	254	258
22 Utilities	27	28	29	29	30	30	31
23 Construction	108	115	125	127	129	132	134
31-33 Manufacturing	56	55	53	54	55	56	57
42 Wholesale trade	40	41	43	44	44	45	46
44-45 Retail trade	90	92	95	97	98	100	101
48-49 Transportation and warehousing	83	85	90	91	93	94	96
51 Information	9	9	9	9	10	10	10
52 Finance and insurance	45	46	48	49	50	51	51
53 Real estate and rental and leasing	6	6	7	7	7	7	7
54 Professional and technical services	64	70	79	80	82	83	84
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	18	19	22	22	22	23	23
61 Educational services	240	251	269	274	278	283	287
62 Health care and social assistance	92	97	107	108	110	112	114
71 Arts, entertainment, and recreation	32	35	40	41	42	42	43
72 Accommodation and food services	76	80	87	88	90	91	93
81 Other services, except public administration	26	27	28	29	29	30	30
92 Public Administration	105	109	115	117	119	121	123
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	293	305	324	329	335	340	346
Public-Supply Residential Including System Losses (AFY)	405	409	416	423	430	437	444
Self-Supply Residential (AFY)	346	350	355	361	367	373	379
Projection of Irrigated Lands (in Acres)	28,512	28,763	29,598	30,434	31,269	31,910	32,940
Crop Irrigation (AFY)	32,357	32,642	33,590	34,538	35,486	36,214	37,383
Livestock (AFY)	3,052	3,067	3,120	3,172	3,224	3,276	3,328
Oil and Gas Drilling (AFY)	496	698	975	1,300	1,674	2,096	2,566
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	364	375	393	400	406	413	419
Total Water Demand, All Sectors (AFY)*	**37,314**	**37,846**	**39,173**	**40,524**	**41,923**	**43,149**	**44,865**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Beckham	2007	2010	2020	2030	2040	2050	2060
Population, Total	19,700	20,212	22,015	23,913	25,811	27,709	29,797
Public-Supplied Population	17,720	18,181	19,803	21,510	23,217	24,924	26,802
Self-Supplied Population	1,980	2,032	2,213	2,403	2,594	2,785	2,995
Employment, Total	8,599	8,951	9,562	10,387	11,211	12,036	12,942
11 Agriculture, forestry, fishing and hunting	52	53	54	59	64	68	74
21 Mining, quarrying, and oil and gas extraction	1,295	1,334	1,406	1,527	1,648	1,769	1,903
22 Utilities	102	104	109	118	127	137	147
23 Construction	385	410	450	489	528	567	609
31-33 Manufacturing	344	337	330	358	387	415	447
42 Wholesale trade	336	345	361	393	424	455	489
44-45 Retail trade	1,374	1,403	1,458	1,584	1,710	1,836	1,974
48-49 Transportation and warehousing	385	398	421	457	494	530	570
51 Information	72	74	78	85	91	98	105
52 Finance and insurance	313	322	338	367	396	426	458
53 Real estate and rental and leasing	276	291	316	343	371	398	428
54 Professional and technical services	123	135	153	167	180	193	208
55 Management of companies and enterprises	5	5	5	5	6	6	6
56 Administrative and waste services	305	328	367	398	430	462	496
61 Educational services	608	637	686	745	804	863	928
62 Health care and social assistance	1,276	1,359	1,496	1,625	1,754	1,883	2,024
71 Arts, entertainment, and recreation	32	36	41	45	49	52	56
72 Accommodation and food services	852	901	982	1,067	1,151	1,236	1,329
81 Other services, except public administration	164	170	180	196	211	227	244
92 Public Administration	292	304	323	351	379	407	437
99 Unclassified	7	7	7	8	8	9	10
Public-Supply Nonresidential Including System Losses (AFY)	1,598	1,659	1,766	1,918	2,071	2,223	2,390
Public-Supply Residential Including System Losses (AFY)	3,001	3,079	3,354	3,643	3,932	4,222	4,540
Self-Supply Residential (AFY)	313	321	349	380	410	440	473
Projection of Irrigated Lands (in Acres)	6,895	6,895	6,895	6,895	6,895	6,895	6,895
Crop Irrigation (AFY)	8,718	8,718	8,718	8,718	8,718	8,718	8,718
Livestock (AFY)	762	770	795	820	846	871	897
Oil and Gas Drilling (AFY)	352	497	702	945	1,226	1,544	1,900
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**14,744**	**15,044**	**15,685**	**16,425**	**17,202**	**18,018**	**18,918**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Blaine	2007	2010	2020	2030	2040	2050	2060
Population, Total	12,475	12,717	13,827	15,039	16,250	17,461	18,773
Public-Supplied Population	11,345	11,565	12,575	13,676	14,778	15,879	17,073
Self-Supplied Population	1,130	1,152	1,253	1,362	1,472	1,582	1,700
Employment, Total	3,094	3,228	3,453	3,756	4,058	4,361	4,688
11 Agriculture, forestry, fishing and hunting	35	36	37	40	43	46	50
21 Mining, quarrying, and oil and gas extraction	142	146	154	167	181	194	209
22 Utilities	35	36	37	41	44	47	51
23 Construction	132	141	154	168	182	195	210
31-33 Manufacturing	141	138	135	147	159	171	183
42 Wholesale trade	147	151	158	172	186	199	214
44-45 Retail trade	282	288	299	325	351	377	406
48-49 Transportation and warehousing	172	177	187	204	220	237	254
51 Information	65	66	70	76	82	88	95
52 Finance and insurance	124	128	134	145	157	169	182
53 Real estate and rental and leasing	52	55	59	65	70	75	81
54 Professional and technical services	62	68	77	84	91	97	105
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	116	125	140	152	164	177	190
61 Educational services	399	418	449	489	528	568	610
62 Health care and social assistance	392	417	459	499	539	579	623
71 Arts, entertainment, and recreation	45	50	58	63	68	73	79
72 Accommodation and food services	326	344	375	408	440	473	509
81 Other services, except public administration	107	111	117	128	138	148	159
92 Public Administration	320	332	353	384	415	446	480
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	453	473	506	551	595	639	688
Public-Supply Residential Including System Losses (AFY)	1,964	2,002	2,176	2,367	2,558	2,748	2,955
Self-Supply Residential (AFY)	186	189	206	224	242	260	280
Projection of Irrigated Lands (in Acres)	5,845	5,845	5,845	5,845	5,845	5,845	5,845
Crop Irrigation (AFY)	6,517	6,517	6,517	6,517	6,517	6,517	6,517
Livestock (AFY)	1,566	1,565	1,564	1,562	1,560	1,558	1,557
Oil and Gas Drilling (AFY)	211	296	405	531	674	834	1,011
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	317	311	304	330	357	383	412
Total Water Demand, All Sectors (AFY)*	**11,212**	**11,352**	**11,677**	**12,081**	**12,502**	**12,940**	**13,418**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Bryan	2007	2010	2020	2030	2040	2050	2060
Population, Total	39,563	40,827	45,040	49,353	53,667	57,980	62,394
Public-Supplied Population	36,783	37,958	41,875	45,885	49,896	53,906	58,010
Self-Supplied Population	2,780	2,869	3,165	3,468	3,771	4,074	4,384
Employment, Total	15,939	16,662	17,914	19,629	21,345	23,060	24,816
11 Agriculture, forestry, fishing and hunting	195	198	204	224	243	263	283
21 Mining, quarrying, and oil and gas extraction	12	12	13	14	16	17	18
22 Utilities	110	112	117	128	140	151	162
23 Construction	331	352	387	424	461	498	536
31-33 Manufacturing	1,386	1,359	1,331	1,458	1,585	1,713	1,843
42 Wholesale trade	675	693	726	796	866	935	1,006
44-45 Retail trade	1,467	1,498	1,558	1,708	1,857	2,006	2,159
48-49 Transportation and warehousing	229	237	251	275	299	323	347
51 Information	339	348	366	401	436	471	507
52 Finance and insurance	459	472	496	544	591	639	687
53 Real estate and rental and leasing	100	105	115	126	137	148	159
54 Professional and technical services	601	658	749	821	893	965	1,038
55 Management of companies and enterprises	79	79	79	86	94	101	109
56 Administrative and waste services	1,323	1,425	1,593	1,746	1,899	2,051	2,207
61 Educational services	1,881	1,970	2,124	2,327	2,530	2,734	2,942
62 Health care and social assistance	1,905	2,029	2,235	2,449	2,663	2,877	3,096
71 Arts, entertainment, and recreation	863	956	1,107	1,213	1,319	1,425	1,533
72 Accommodation and food services	1,212	1,281	1,397	1,531	1,665	1,799	1,936
81 Other services, except public administration	232	240	255	280	304	328	353
92 Public Administration	2,540	2,637	2,810	3,079	3,348	3,617	3,893
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	2,405	2,533	2,751	3,014	3,277	3,541	3,810
Public-Supply Residential Including System Losses (AFY)	5,439	5,613	6,192	6,785	7,378	7,971	8,577
Self-Supply Residential (AFY)	357	369	407	446	485	524	564
Projection of Irrigated Lands (in Acres)	9,492	9,528	9,647	9,766	9,886	9,977	10,124
Crop Irrigation (AFY)	17,044	17,108	17,322	17,536	17,750	17,915	18,178
Livestock (AFY)	1,562	1,564	1,567	1,571	1,575	1,579	1,582
Oil and Gas Drilling (AFY)	17	24	33	43	54	67	82
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**26,824**	**27,209**	**28,271**	**29,395**	**30,519**	**31,596**	**32,794**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Caddo	2007	2010	2020	2030	2040	2050	2060
Population, Total	29,296	29,584	30,833	31,793	32,754	33,714	34,579
Public-Supplied Population	17,566	17,739	18,487	19,063	19,639	20,215	20,734
Self-Supplied Population	11,730	11,845	12,345	12,730	13,115	13,499	13,845
Employment, Total	6,988	7,286	7,766	8,008	8,250	8,492	8,710
11 Agriculture, forestry, fishing and hunting	187	190	195	201	207	213	218
21 Mining, quarrying, and oil and gas extraction	148	153	160	165	170	175	179
22 Utilities	391	400	415	428	441	454	465
23 Construction	251	267	292	301	311	320	328
31-33 Manufacturing	52	51	50	51	53	54	56
42 Wholesale trade	259	266	277	286	295	303	311
44-45 Retail trade	989	1,010	1,045	1,078	1,110	1,143	1,172
48-49 Transportation and warehousing	88	91	96	99	102	105	107
51 Information	99	102	107	110	113	117	120
52 Finance and insurance	254	261	273	282	290	299	306
53 Real estate and rental and leasing	33	35	37	39	40	41	42
54 Professional and technical services	128	140	159	163	168	173	178
55 Management of companies and enterprises	7	7	7	7	8	8	8
56 Administrative and waste services	212	228	254	261	269	277	284
61 Educational services	1,103	1,155	1,239	1,277	1,316	1,354	1,389
62 Health care and social assistance	1,005	1,070	1,173	1,210	1,246	1,283	1,316
71 Arts, entertainment, and recreation	78	86	99	102	105	108	111
72 Accommodation and food services	279	295	320	330	340	350	359
81 Other services, except public administration	50	52	55	56	58	60	61
92 Public Administration	1,375	1,428	1,513	1,561	1,608	1,655	1,697
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	876	916	981	1,011	1,042	1,072	1,100
Public-Supply Residential Including System Losses (AFY)	2,365	2,389	2,489	2,567	2,645	2,722	2,792
Self-Supply Residential (AFY)	1,422	1,436	1,496	1,543	1,589	1,636	1,678
Projection of Irrigated Lands (in Acres)	33,152	34,028	36,950	39,871	42,793	45,035	48,636
Crop Irrigation (AFY)	30,829	31,644	34,361	37,078	39,794	41,879	45,228
Livestock (AFY)	2,281	2,281	2,281	2,281	2,281	2,281	2,282
Oil and Gas Drilling (AFY)	395	556	783	1,051	1,360	1,711	2,102
Thermoelectric, Withdrawals (AFY)	5,010	5,178	5,776	6,444	7,189	8,020	8,947
Thermoelectric, Consumptive Use (AFY)	3,103	3,207	3,578	3,991	4,453	4,967	5,542
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**43,178**	**44,399**	**48,167**	**51,975**	**55,901**	**59,322**	**64,128**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Canadian	2007	2010	2020	2030	2040	2050	2060
Population, Total	103,559	106,854	117,286	125,413	132,441	138,921	145,510
Public-Supplied Population	103,559	106,854	117,286	125,413	132,441	138,921	145,510
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	24,751	25,717	27,401	29,299	30,941	32,455	33,994
11 Agriculture, forestry, fishing and hunting	156	158	163	174	184	193	202
21 Mining, quarrying, and oil and gas extraction	1,221	1,258	1,325	1,417	1,497	1,570	1,644
22 Utilities	360	368	383	410	433	454	475
23 Construction	2,017	2,145	2,356	2,519	2,661	2,791	2,923
31-33 Manufacturing	3,147	3,085	3,019	3,228	3,409	3,576	3,745
42 Wholesale trade	695	713	747	799	844	885	927
44-45 Retail trade	2,983	3,045	3,166	3,386	3,576	3,750	3,928
48-49 Transportation and warehousing	867	897	949	1,014	1,071	1,124	1,177
51 Information	218	224	235	251	265	278	291
52 Finance and insurance	719	739	777	831	877	920	964
53 Real estate and rental and leasing	486	512	557	595	629	659	691
54 Professional and technical services	672	735	837	895	946	992	1,039
55 Management of companies and enterprises	60	60	60	64	67	71	74
56 Administrative and waste services	912	983	1,098	1,174	1,240	1,301	1,363
61 Educational services	2,722	2,851	3,071	3,283	3,467	3,637	3,809
62 Health care and social assistance	1,928	2,053	2,260	2,416	2,552	2,676	2,803
71 Arts, entertainment, and recreation	694	769	890	951	1,005	1,054	1,104
72 Accommodation and food services	2,191	2,316	2,525	2,700	2,851	2,991	3,133
81 Other services, except public administration	611	633	671	718	758	795	833
92 Public Administration	2,088	2,168	2,308	2,468	2,606	2,734	2,863
99 Unclassified	4	4	4	4	5	5	5
Public-Supply Nonresidential Including System Losses (AFY)	4,043	4,209	4,497	4,809	5,078	5,326	5,579
Public-Supply Residential Including System Losses (AFY)	10,892	11,239	12,336	13,191	13,930	14,612	15,305
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	3,954	3,996	4,134	4,273	4,412	4,518	4,689
Crop Irrigation (AFY)	6,309	6,376	6,597	6,818	7,040	7,210	7,482
Livestock (AFY)	1,506	1,510	1,525	1,541	1,556	1,571	1,586
Oil and Gas Drilling (AFY)	2,466	3,581	6,905	4,908	3,733	2,120	70
Thermoelectric, Withdrawals (AFY)	2,288	2,364	2,637	2,942	3,282	3,662	4,085
Thermoelectric, Consumptive Use (AFY)	1,417	1,464	1,633	1,822	2,033	2,268	2,530
Self-Supply Large Industry (AFY)	118	115	113	121	127	134	140
Total Water Demand, All Sectors (AFY)*	**27,622**	**29,394**	**34,610**	**34,329**	**34,746**	**34,634**	**34,247**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Carter	2007	2010	2020	2030	2040	2050	2060
Population, Total	47,582	48,254	51,104	53,853	56,500	59,350	62,404
Public-Supplied Population	47,362	48,031	50,868	53,604	56,239	59,076	62,116
Self-Supplied Population	220	223	236	249	261	274	289
Employment, Total	21,926	22,762	24,160	25,459	26,711	28,058	29,502
11 Agriculture, forestry, fishing and hunting	20	20	21	22	23	24	25
21 Mining, quarrying, and oil and gas extraction	976	1,006	1,057	1,114	1,168	1,227	1,290
22 Utilities	229	234	243	256	269	282	297
23 Construction	943	1,002	1,098	1,157	1,214	1,275	1,341
31-33 Manufacturing	3,142	3,080	3,006	3,168	3,323	3,491	3,671
42 Wholesale trade	1,125	1,155	1,207	1,272	1,334	1,401	1,474
44-45 Retail trade	2,396	2,447	2,537	2,673	2,805	2,946	3,098
48-49 Transportation and warehousing	1,594	1,648	1,739	1,832	1,923	2,020	2,123
51 Information	195	200	210	221	232	244	256
52 Finance and insurance	652	671	702	740	777	816	858
53 Real estate and rental and leasing	278	293	318	335	351	369	388
54 Professional and technical services	707	774	879	926	971	1,020	1,073
55 Management of companies and enterprises	35	35	35	37	38	40	42
56 Administrative and waste services	1,286	1,386	1,544	1,627	1,707	1,793	1,886
61 Educational services	1,616	1,692	1,817	1,915	2,009	2,111	2,219
62 Health care and social assistance	3,352	3,569	3,918	4,129	4,332	4,551	4,785
71 Arts, entertainment, and recreation	142	158	182	191	201	211	222
72 Accommodation and food services	1,737	1,836	1,996	2,104	2,207	2,319	2,438
81 Other services, except public administration	505	523	553	583	612	642	675
92 Public Administration	987	1,025	1,088	1,147	1,203	1,264	1,329
99 Unclassified	10	10	10	11	11	12	12
Public-Supply Nonresidential Including System Losses (AFY)	3,299	3,416	3,613	3,807	3,994	4,196	4,412
Public-Supply Residential Including System Losses (AFY)	5,514	5,592	5,922	6,241	6,547	6,878	7,231
Self-Supply Residential (AFY)	22	22	24	25	26	28	29
Projection of Irrigated Lands (in Acres)	1,276	1,281	1,297	1,314	1,330	1,343	1,363
Crop Irrigation (AFY)	2,732	2,742	2,777	2,812	2,847	2,874	2,918
Livestock (AFY)	774	779	797	814	832	849	867
Oil and Gas Drilling (AFY)	2,266	3,291	6,344	4,509	3,430	1,948	64
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	61	63	66	70	73	77	81
Total Water Demand, All Sectors (AFY)*	**14,668**	**15,905**	**19,542**	**18,278**	**17,750**	**16,850**	**15,602**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Cherokee	2007	2010	2020	2030	2040	2050	2060
Population, Total	45,393	47,663	54,755	61,753	68,846	75,750	82,842
Public-Supplied Population	37,963	39,861	45,793	51,645	57,577	63,351	69,282
Self-Supplied Population	7,430	7,802	8,962	10,108	11,269	12,399	13,560
Employment, Total	14,680	15,362	16,598	18,719	20,869	22,962	25,112
11 Agriculture, forestry, fishing and hunting	171	174	180	203	226	249	272
21 Mining, quarrying, and oil and gas extraction	108	111	117	132	147	162	177
22 Utilities	213	218	228	257	286	315	345
23 Construction	372	396	436	492	549	604	660
31-33 Manufacturing	183	179	176	199	222	244	267
42 Wholesale trade	412	423	445	502	559	616	673
44-45 Retail trade	1,557	1,590	1,660	1,872	2,087	2,296	2,511
48-49 Transportation and warehousing	87	90	96	108	120	132	145
51 Information	126	129	136	154	171	189	206
52 Finance and insurance	327	336	355	400	446	491	537
53 Real estate and rental and leasing	87	92	100	113	126	138	151
54 Professional and technical services	147	161	184	207	231	254	278
55 Management of companies and enterprises	85	85	85	96	107	118	129
56 Administrative and waste services	1,080	1,163	1,305	1,472	1,641	1,806	1,975
61 Educational services	3,082	3,227	3,491	3,937	4,389	4,829	5,281
62 Health care and social assistance	1,832	1,951	2,157	2,432	2,712	2,983	3,263
71 Arts, entertainment, and recreation	323	357	415	468	522	574	628
72 Accommodation and food services	1,101	1,164	1,274	1,437	1,602	1,763	1,928
81 Other services, except public administration	301	312	332	375	418	459	502
92 Public Administration	3,079	3,197	3,418	3,855	4,298	4,728	5,171
99 Unclassified	8	8	8	9	10	11	12
Public-Supply Nonresidential Including System Losses (AFY)	2,126	2,233	2,424	2,734	3,048	3,354	3,668
Public-Supply Residential Including System Losses (AFY)	4,429	4,651	5,343	6,026	6,718	7,391	8,084
Self-Supply Residential (AFY)	737	774	889	1,002	1,118	1,230	1,345
Projection of Irrigated Lands (in Acres)	972	986	1,033	1,080	1,127	1,163	1,221
Crop Irrigation (AFY)	1,480	1,501	1,573	1,644	1,716	1,770	1,859
Livestock (AFY)	829	829	830	830	831	832	833
Oil and Gas Drilling (AFY)	1	1	1	1	2	2	3
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**9,601**	**9,988**	**11,059**	**12,238**	**13,432**	**14,579**	**15,790**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Choctaw	2007	2010	2020	2030	2040	2050	2060
Population, Total	15,011	15,127	15,515	15,806	16,194	16,582	16,970
Public-Supplied Population	10,311	10,391	10,657	10,857	11,124	11,390	11,656
Self-Supplied Population	4,700	4,736	4,858	4,949	5,070	5,192	5,313
Employment, Total	4,353	4,555	4,871	4,962	5,084	5,205	5,327
11 Agriculture, forestry, fishing and hunting	30	31	32	32	33	34	35
21 Mining, quarrying, and oil and gas extraction	70	72	75	77	79	81	83
22 Utilities	187	191	198	202	207	212	217
23 Construction	173	184	201	205	210	215	220
31-33 Manufacturing	128	125	122	124	127	130	133
42 Wholesale trade	105	108	112	114	117	120	123
44-45 Retail trade	477	487	504	513	526	538	551
48-49 Transportation and warehousing	147	152	160	163	167	171	175
51 Information	25	26	27	27	28	29	29
52 Finance and insurance	110	113	118	120	123	126	129
53 Real estate and rental and leasing	37	39	42	43	44	45	46
54 Professional and technical services	104	114	129	131	134	138	141
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	62	67	74	76	77	79	81
61 Educational services	928	972	1,040	1,060	1,086	1,112	1,138
62 Health care and social assistance	831	885	968	986	1,010	1,034	1,058
71 Arts, entertainment, and recreation	153	169	194	198	203	208	213
72 Accommodation and food services	275	291	315	321	329	337	345
81 Other services, except public administration	272	281	297	302	310	317	324
92 Public Administration	239	248	263	267	274	281	287
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	684	720	775	789	809	828	847
Public-Supply Residential Including System Losses (AFY)	834	840	862	878	899	921	942
Self-Supply Residential (AFY)	324	326	335	341	349	358	366
Projection of Irrigated Lands (in Acres)	527	556	651	747	842	915	1,033
Crop Irrigation (AFY)	815	859	1,007	1,154	1,302	1,415	1,597
Livestock (AFY)	1,010	1,010	1,012	1,013	1,015	1,016	1,018
Oil and Gas Drilling (AFY)	0	0	0	0	0	0	0
Thermoelectric, Withdrawals (AFY)	7,069	7,304	8,149	9,091	10,142	11,314	12,623
Thermoelectric, Consumptive Use (AFY)	4,378	4,524	5,047	5,631	6,281	7,008	7,818
Self-Supply Large Industry (AFY)	92	95	99	101	104	101	99
Total Water Demand, All Sectors (AFY)*	**10,827**	**11,155**	**12,238**	**13,368**	**14,620**	**15,954**	**17,493**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Cimarron	2007	2010	2020	2030	2040	2050	2060
Population, Total	2,664	2,664	2,831	2,914	2,914	2,997	3,080
Public-Supplied Population	1,544	1,544	1,641	1,689	1,689	1,737	1,785
Self-Supplied Population	1,120	1,120	1,190	1,225	1,225	1,260	1,295
Employment, Total	713	739	782	805	805	829	852
11 Agriculture, forestry, fishing and hunting	37	37	38	40	40	41	42
21 Mining, quarrying, and oil and gas extraction	0	0	0	0	0	0	0
22 Utilities	21	22	23	23	23	24	25
23 Construction	21	22	25	25	25	26	27
31-33 Manufacturing	58	57	55	57	57	59	60
42 Wholesale trade	30	31	32	33	33	34	35
44-45 Retail trade	87	89	92	95	95	98	100
48-49 Transportation and warehousing	30	31	33	34	34	35	36
51 Information	5	5	5	6	6	6	6
52 Finance and insurance	39	40	42	43	43	44	46
53 Real estate and rental and leasing	0	0	0	0	0	0	0
54 Professional and technical services	10	11	12	13	13	13	14
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	0	0	0	0	0	0	0
61 Educational services	140	147	158	162	162	167	172
62 Health care and social assistance	79	85	93	96	96	98	101
71 Arts, entertainment, and recreation	0	0	0	0	0	0	0
72 Accommodation and food services	66	70	76	78	78	80	83
81 Other services, except public administration	17	18	19	19	19	20	20
92 Public Administration	72	75	79	82	82	84	86
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	95	98	104	107	107	110	113
Public-Supply Residential Including System Losses (AFY)	547	547	581	598	598	615	632
Self-Supply Residential (AFY)	337	337	358	369	369	379	390
Projection of Irrigated Lands (in Acres)	45,513	46,800	51,091	55,383	59,674	62,967	68,256
Crop Irrigation (AFY)	60,416	62,125	67,821	73,517	79,214	83,585	90,606
Livestock (AFY)	1,897	1,907	1,940	1,974	2,008	2,041	2,075
Oil and Gas Drilling (AFY)	47	65	90	117	149	185	224
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**63,338**	**65,080**	**70,895**	**76,683**	**82,445**	**86,916**	**94,040**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Cleveland	2007	2010	2020	2030	2040	2050	2060
Population, Total	236,452	243,459	261,555	276,180	287,858	296,065	304,061
Public-Supplied Population	223,782	230,414	247,540	261,381	272,434	280,200	287,768
Self-Supplied Population	12,670	13,045	14,015	14,799	15,425	15,864	16,293
Employment, Total	70,643	74,043	79,643	84,096	87,652	90,151	92,585
11 Agriculture, forestry, fishing and hunting	73	74	76	80	84	86	89
21 Mining, quarrying, and oil and gas extraction	211	217	229	241	251	259	266
22 Utilities	776	794	825	871	908	934	959
23 Construction	3,941	4,190	4,593	4,850	5,055	5,199	5,339
31-33 Manufacturing	3,542	3,473	3,390	3,579	3,731	3,837	3,941
42 Wholesale trade	1,677	1,721	1,799	1,900	1,980	2,037	2,092
44-45 Retail trade	8,467	8,644	8,967	9,468	9,868	10,150	10,424
48-49 Transportation and warehousing	659	681	719	759	791	814	836
51 Information	781	803	840	887	925	951	977
52 Finance and insurance	2,051	2,109	2,210	2,334	2,433	2,502	2,570
53 Real estate and rental and leasing	1,162	1,225	1,328	1,402	1,461	1,503	1,543
54 Professional and technical services	3,323	3,636	4,131	4,362	4,547	4,676	4,803
55 Management of companies and enterprises	234	233	232	245	256	263	270
56 Administrative and waste services	5,027	5,415	6,037	6,374	6,644	6,833	7,018
61 Educational services	12,628	13,226	14,210	15,005	15,639	16,085	16,520
62 Health care and social assistance	9,865	10,504	11,536	12,181	12,696	13,058	13,411
71 Arts, entertainment, and recreation	1,438	1,594	1,839	1,941	2,023	2,081	2,137
72 Accommodation and food services	8,263	8,734	9,500	10,031	10,455	10,754	11,044
81 Other services, except public administration	1,609	1,666	1,763	1,862	1,941	1,996	2,050
92 Public Administration	4,880	5,067	5,382	5,683	5,923	6,092	6,256
99 Unclassified	36	36	36	38	40	41	42
Public-Supply Nonresidential Including System Losses (AFY)	9,866	10,369	11,193	11,818	12,318	12,669	13,012
Public-Supply Residential Including System Losses (AFY)	26,529	27,315	29,345	30,986	32,296	33,217	34,114
Self-Supply Residential (AFY)	1,291	1,329	1,428	1,508	1,571	1,616	1,660
Projection of Irrigated Lands (in Acres)	1,139	1,202	1,410	1,619	1,827	1,987	2,244
Crop Irrigation (AFY)	1,106	1,166	1,369	1,571	1,773	1,929	2,178
Livestock (AFY)	418	421	433	444	456	467	479
Oil and Gas Drilling (AFY)	52	75	122	182	255	340	437
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**39,261**	**40,675**	**43,889**	**46,510**	**48,670**	**50,238**	**51,879**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Coal	2007	2010	2020	2030	2040	2050	2060
Population, Total	5,709	5,869	6,758	7,648	8,626	9,693	10,760
Public-Supplied Population	4,139	4,255	4,900	5,544	6,254	7,027	7,801
Self-Supplied Population	1,570	1,614	1,859	2,103	2,372	2,666	2,959
Employment, Total	1,049	1,096	1,183	1,338	1,509	1,696	1,883
11 Agriculture, forestry, fishing and hunting	15	15	16	18	20	22	25
21 Mining, quarrying, and oil and gas extraction	19	19	20	23	26	29	32
22 Utilities	26	26	27	31	35	39	44
23 Construction	51	55	60	68	77	86	96
31-33 Manufacturing	26	25	25	28	32	36	40
42 Wholesale trade	12	12	13	15	17	19	21
44-45 Retail trade	145	148	155	175	197	222	246
48-49 Transportation and warehousing	31	32	34	38	43	49	54
51 Information	0	0	0	0	0	0	0
52 Finance and insurance	46	47	50	56	64	72	79
53 Real estate and rental and leasing	0	0	0	0	0	0	0
54 Professional and technical services	16	18	20	23	26	29	32
55 Management of companies and enterprises	11	11	11	12	14	16	18
56 Administrative and waste services	16	17	19	22	25	28	31
61 Educational services	216	226	245	277	312	351	390
62 Health care and social assistance	225	240	265	300	338	380	422
71 Arts, entertainment, and recreation	30	33	38	43	49	55	61
72 Accommodation and food services	20	21	24	27	30	34	37
81 Other services, except public administration	6	6	6	7	8	9	10
92 Public Administration	139	144	154	175	197	221	246
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	145	153	166	188	212	238	264
Public-Supply Residential Including System Losses (AFY)	461	473	545	617	696	782	868
Self-Supply Residential (AFY)	148	153	176	199	224	252	280
Projection of Irrigated Lands (in Acres)	469	470	471	473	475	477	479
Crop Irrigation (AFY)	637	637	640	643	645	647	650
Livestock (AFY)	590	596	619	642	665	688	711
Oil and Gas Drilling (AFY)	1,206	1,750	3,375	2,399	1,825	1,036	34
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**3,186**	**3,763**	**5,521**	**4,687**	**4,267**	**3,644**	**2,808**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Comanche	2007	2010	2020	2030	2040	2050	2060
Population, Total	113,811	128,490	137,442	144,210	149,473	153,609	156,993
Public-Supplied Population	111,621	126,017	134,797	141,435	146,597	150,653	153,972
Self-Supplied Population	2,190	2,472	2,645	2,775	2,876	2,956	3,021
Employment, Total	40,220	41,929	44,742	46,946	48,659	50,006	51,107
11 Agriculture, forestry, fishing and hunting	75	76	78	82	85	87	89
21 Mining, quarrying, and oil and gas extraction	129	133	140	146	152	156	159
22 Utilities	321	328	341	358	371	381	389
23 Construction	1,573	1,673	1,832	1,922	1,993	2,048	2,093
31-33 Manufacturing	3,614	3,543	3,456	3,626	3,759	3,863	3,948
42 Wholesale trade	609	625	653	685	710	730	746
44-45 Retail trade	5,714	5,834	6,047	6,345	6,576	6,758	6,907
48-49 Transportation and warehousing	1,246	1,288	1,359	1,426	1,478	1,519	1,552
51 Information	555	570	597	626	649	667	682
52 Finance and insurance	1,777	1,827	1,914	2,008	2,081	2,139	2,186
53 Real estate and rental and leasing	513	541	586	614	637	654	669
54 Professional and technical services	1,193	1,305	1,482	1,555	1,612	1,656	1,693
55 Management of companies and enterprises	68	68	67	71	73	75	77
56 Administrative and waste services	2,225	2,397	2,671	2,802	2,904	2,985	3,051
61 Educational services	4,537	4,752	5,102	5,354	5,549	5,703	5,828
62 Health care and social assistance	6,635	7,066	7,754	8,136	8,433	8,667	8,857
71 Arts, entertainment, and recreation	528	585	675	708	734	754	771
72 Accommodation and food services	3,812	4,029	4,380	4,595	4,763	4,895	5,003
81 Other services, except public administration	888	920	973	1,021	1,058	1,087	1,111
92 Public Administration	4,204	4,365	4,633	4,861	5,039	5,178	5,292
99 Unclassified	3	3	3	3	3	3	3
Public-Supply Nonresidential Including System Losses (AFY)	5,313	5,545	5,926	6,218	6,445	6,623	6,769
Public-Supply Residential Including System Losses (AFY)	9,865	11,137	11,913	12,499	12,956	13,314	13,607
Self-Supply Residential (AFY)	171	193	207	217	225	231	236
Projection of Irrigated Lands (in Acres)	1,449	1,482	1,592	1,702	1,812	1,896	2,032
Crop Irrigation (AFY)	2,630	2,690	2,890	3,089	3,289	3,442	3,688
Livestock (AFY)	1,002	1,008	1,029	1,049	1,070	1,090	1,111
Oil and Gas Drilling (AFY)	38	53	73	95	121	150	181
Thermoelectric, Withdrawals (AFY)	2,484	2,566	2,863	3,194	3,563	3,975	4,435
Thermoelectric, Consumptive Use (AFY)	1,538	1,590	1,773	1,978	2,207	2,462	2,747
Self-Supply Large Industry (AFY)	362	355	346	363	377	387	396
Total Water Demand, All Sectors (AFY)*	**21,864**	**23,548**	**25,246**	**26,726**	**28,045**	**29,213**	**30,424**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Cotton	2007	2010	2020	2030	2040	2050	2060
Population, Total	6,299	6,357	6,453	6,549	6,646	6,838	6,935
Public-Supplied Population	6,299	6,357	6,453	6,549	6,646	6,838	6,935
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	1,449	1,513	1,614	1,638	1,662	1,710	1,734
11 Agriculture, forestry, fishing and hunting	9	9	10	10	10	10	10
21 Mining, quarrying, and oil and gas extraction	104	108	113	114	116	119	121
22 Utilities	27	28	29	29	29	30	31
23 Construction	15	16	17	18	18	18	19
31-33 Manufacturing	13	13	12	13	13	13	13
42 Wholesale trade	34	35	36	37	37	38	39
44-45 Retail trade	113	115	119	121	122	126	128
48-49 Transportation and warehousing	28	29	30	31	31	32	33
51 Information	10	10	11	11	11	11	11
52 Finance and insurance	46	47	49	50	51	52	53
53 Real estate and rental and leasing	0	0	0	0	0	0	0
54 Professional and technical services	8	9	10	10	10	11	11
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	32	34	38	39	39	40	41
61 Educational services	316	331	354	359	365	375	381
62 Health care and social assistance	179	190	208	211	214	221	224
71 Arts, entertainment, and recreation	28	31	35	36	36	38	38
72 Accommodation and food services	114	121	131	133	135	139	141
81 Other services, except public administration	21	22	23	24	24	25	25
92 Public Administration	353	366	388	394	399	411	417
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	264	276	295	299	303	312	317
Public-Supply Residential Including System Losses (AFY)	502	507	514	522	530	545	553
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	331	350	414	478	541	590	669
Crop Irrigation (AFY)	549	581	687	793	898	980	1,110
Livestock (AFY)	940	942	950	957	965	972	979
Oil and Gas Drilling (AFY)	7	10	14	18	23	28	34
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**2,263**	**2,316**	**2,459**	**2,589**	**2,719**	**2,837**	**2,993**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Craig	2007	2010	2020	2030	2040	2050	2060
Population, Total	15,195	15,650	17,358	18,970	20,772	22,574	24,471
Public-Supplied Population	14,395	14,826	16,444	17,971	19,679	21,386	23,183
Self-Supplied Population	800	824	914	999	1,094	1,189	1,288
Employment, Total	5,925	6,147	6,544	7,152	7,832	8,511	9,227
11 Agriculture, forestry, fishing and hunting	167	170	175	192	210	228	247
21 Mining, quarrying, and oil and gas extraction	53	54	57	63	68	74	81
22 Utilities	255	261	272	298	326	354	384
23 Construction	177	188	207	226	248	269	292
31-33 Manufacturing	683	670	656	717	785	853	925
42 Wholesale trade	219	225	236	258	282	307	332
44-45 Retail trade	609	622	647	707	775	842	913
48-49 Transportation and warehousing	189	195	207	226	247	269	291
51 Information	89	91	96	105	115	125	136
52 Finance and insurance	215	221	233	254	278	302	328
53 Real estate and rental and leasing	26	27	30	33	36	39	42
54 Professional and technical services	261	286	326	356	390	424	459
55 Management of companies and enterprises	94	93	93	102	112	122	132
56 Administrative and waste services	162	175	195	213	234	254	275
61 Educational services	802	840	906	990	1,084	1,178	1,277
62 Health care and social assistance	804	857	944	1,032	1,130	1,228	1,331
71 Arts, entertainment, and recreation	19	21	24	27	29	32	34
72 Accommodation and food services	473	500	546	596	653	710	769
81 Other services, except public administration	102	106	112	123	134	146	158
92 Public Administration	525	545	581	635	695	756	819
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	793	822	874	955	1,046	1,137	1,232
Public-Supply Residential Including System Losses (AFY)	1,429	1,472	1,632	1,784	1,954	2,123	2,302
Self-Supply Residential (AFY)	68	70	77	84	92	100	109
Projection of Irrigated Lands (in Acres)	0	98	424	749	1,075	1,325	1,727
Crop Irrigation (AFY)	0	147	638	1,128	1,618	1,995	2,599
Livestock (AFY)	1,683	1,684	1,689	1,694	1,699	1,703	1,708
Oil and Gas Drilling (AFY)	21	30	41	54	68	84	102
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**3,994**	**4,225**	**4,951**	**5,699**	**6,477**	**7,142**	**8,052**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Creek	2007	2010	2020	2030	2040	2050	2060
Population, Total	69,073	70,543	75,441	79,262	82,888	86,513	90,432
Public-Supplied Population	62,023	63,343	67,741	71,172	74,428	77,683	81,202
Self-Supplied Population	7,050	7,200	7,700	8,090	8,460	8,830	9,230
Employment, Total	16,962	17,558	18,569	19,509	20,402	21,294	22,258
11 Agriculture, forestry, fishing and hunting	26	26	27	28	29	31	32
21 Mining, quarrying, and oil and gas extraction	819	844	887	932	974	1,017	1,063
22 Utilities	178	182	189	199	208	217	227
23 Construction	1,617	1,719	1,884	1,980	2,070	2,161	2,259
31-33 Manufacturing	3,331	3,266	3,188	3,349	3,502	3,655	3,821
42 Wholesale trade	779	800	836	878	918	958	1,002
44-45 Retail trade	1,889	1,929	2,000	2,102	2,198	2,294	2,398
48-49 Transportation and warehousing	650	672	709	745	779	813	850
51 Information	143	147	154	161	169	176	184
52 Finance and insurance	562	578	606	636	665	695	726
53 Real estate and rental and leasing	75	79	86	90	94	98	103
54 Professional and technical services	703	769	874	918	960	1,002	1,048
55 Management of companies and enterprises	29	28	28	30	31	33	34
56 Administrative and waste services	633	682	760	799	835	872	911
61 Educational services	1,140	1,193	1,282	1,347	1,409	1,470	1,537
62 Health care and social assistance	2,100	2,236	2,455	2,580	2,698	2,815	2,943
71 Arts, entertainment, and recreation	200	222	256	269	281	294	307
72 Accommodation and food services	982	1,038	1,129	1,186	1,240	1,295	1,353
81 Other services, except public administration	334	346	366	384	402	419	438
92 Public Administration	767	796	846	889	929	970	1,014
99 Unclassified	7	7	7	7	8	8	8
Public-Supply Nonresidential Including System Losses (AFY)	2,685	2,772	2,921	3,069	3,209	3,349	3,501
Public-Supply Residential Including System Losses (AFY)	5,510	5,627	6,018	6,323	6,612	6,901	7,214
Self-Supply Residential (AFY)	532	544	581	611	639	667	697
Projection of Irrigated Lands (in Acres)	319	331	371	411	451	482	531
Crop Irrigation (AFY)	336	349	391	433	475	508	560
Livestock (AFY)	650	654	668	683	697	712	726
Oil and Gas Drilling (AFY)	154	216	295	387	492	608	737
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**9,867**	**10,161**	**10,875**	**11,506**	**12,124**	**12,745**	**13,435**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Custer	2007	2010	2020	2030	2040	2050	2060
Population, Total	26,111	26,571	27,818	28,970	30,121	30,984	31,751
Public-Supplied Population	22,791	23,193	24,281	25,286	26,291	27,044	27,714
Self-Supplied Population	3,320	3,379	3,537	3,683	3,830	3,940	4,037
Employment, Total	11,128	11,585	12,314	12,824	13,333	13,715	14,055
11 Agriculture, forestry, fishing and hunting	37	38	38	40	42	43	44
21 Mining, quarrying, and oil and gas extraction	458	472	495	515	536	551	565
22 Utilities	140	143	148	155	161	165	169
23 Construction	659	701	766	798	829	853	874
31-33 Manufacturing	1,184	1,161	1,130	1,177	1,223	1,258	1,290
42 Wholesale trade	429	440	459	478	497	511	524
44-45 Retail trade	1,533	1,565	1,619	1,686	1,753	1,803	1,848
48-49 Transportation and warehousing	254	263	276	288	299	308	315
51 Information	143	147	153	160	166	171	175
52 Finance and insurance	354	364	380	396	412	424	434
53 Real estate and rental and leasing	184	194	210	218	227	233	239
54 Professional and technical services	322	352	399	416	432	445	456
55 Management of companies and enterprises	9	9	9	9	10	10	10
56 Administrative and waste services	182	196	217	226	235	242	248
61 Educational services	417	436	468	487	506	521	534
62 Health care and social assistance	2,486	2,647	2,899	3,019	3,139	3,229	3,309
71 Arts, entertainment, and recreation	155	172	198	206	215	221	226
72 Accommodation and food services	1,140	1,205	1,307	1,361	1,415	1,456	1,492
81 Other services, except public administration	371	384	405	422	439	452	463
92 Public Administration	652	677	717	747	776	799	818
99 Unclassified	19	19	19	20	21	21	22
Public-Supply Nonresidential Including System Losses (AFY)	1,743	1,815	1,929	2,009	2,089	2,149	2,202
Public-Supply Residential Including System Losses (AFY)	3,463	3,525	3,690	3,843	3,995	4,110	4,212
Self-Supply Residential (AFY)	440	447	468	488	507	522	535
Projection of Irrigated Lands (in Acres)	4,137	4,161	4,241	4,321	4,400	4,462	4,560
Crop Irrigation (AFY)	4,746	4,774	4,865	4,957	5,048	5,119	5,232
Livestock (AFY)	1,242	1,254	1,294	1,335	1,375	1,415	1,455
Oil and Gas Drilling (AFY)	367	519	755	1,039	1,371	1,751	2,179
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	24	23	23	23	24	25	26
Total Water Demand, All Sectors (AFY)*	**12,025**	**12,357**	**13,025**	**13,693**	**14,410**	**15,090**	**15,840**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Delaware	2007	2010	2020	2030	2040	2050	2060
Population, Total	40,406	42,276	48,608	54,745	61,077	67,895	75,006
Public-Supplied Population	28,906	30,244	34,774	39,164	43,693	48,572	53,659
Self-Supplied Population	11,500	12,032	13,834	15,581	17,383	19,324	21,348
Employment, Total	7,900	8,276	8,954	10,084	11,250	12,506	13,816
11 Agriculture, forestry, fishing and hunting	17	17	18	20	23	25	28
21 Mining, quarrying, and oil and gas extraction	6	7	7	8	9	10	11
22 Utilities	54	55	58	65	72	80	89
23 Construction	548	583	643	725	808	899	993
31-33 Manufacturing	486	476	468	527	588	654	722
42 Wholesale trade	99	102	107	120	134	149	165
44-45 Retail trade	1,218	1,244	1,298	1,462	1,631	1,814	2,004
48-49 Transportation and warehousing	109	113	120	135	150	167	184
51 Information	91	94	99	111	124	138	152
52 Finance and insurance	219	225	238	268	299	332	367
53 Real estate and rental and leasing	77	81	89	100	111	124	137
54 Professional and technical services	174	190	218	245	274	304	336
55 Management of companies and enterprises	15	15	15	17	19	21	24
56 Administrative and waste services	171	184	206	232	259	288	318
61 Educational services	429	449	486	547	611	679	750
62 Health care and social assistance	2,068	2,202	2,435	2,742	3,059	3,401	3,757
71 Arts, entertainment, and recreation	306	339	394	444	495	551	608
72 Accommodation and food services	982	1,038	1,137	1,280	1,428	1,587	1,754
81 Other services, except public administration	309	320	341	384	428	476	526
92 Public Administration	521	541	578	651	727	808	892
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	1,208	1,273	1,389	1,564	1,745	1,940	2,143
Public-Supply Residential Including System Losses (AFY)	2,820	2,950	3,392	3,820	4,262	4,738	5,234
Self-Supply Residential (AFY)	954	998	1,147	1,292	1,441	1,602	1,770
Projection of Irrigated Lands (in Acres)	624	624	624	624	624	624	624
Crop Irrigation (AFY)	949	949	949	949	949	949	949
Livestock (AFY)	2,293	2,310	2,368	2,425	2,483	2,540	2,598
Oil and Gas Drilling (AFY)	0	0	0	0	0	0	0
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**8,224**	**8,481**	**9,245**	**10,051**	**10,881**	**11,770**	**12,694**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Dewey	2007	2010	2020	2030	2040	2050	2060
Population, Total	4,338	4,338	4,244	4,244	4,244	4,338	4,432
Public-Supplied Population	3,268	3,268	3,197	3,197	3,197	3,268	3,339
Self-Supplied Population	1,070	1,070	1,047	1,047	1,047	1,070	1,093
Employment, Total	1,248	1,298	1,372	1,372	1,372	1,402	1,433
11 Agriculture, forestry, fishing and hunting	10	11	11	11	11	11	11
21 Mining, quarrying, and oil and gas extraction	147	151	158	158	158	162	165
22 Utilities	45	46	48	48	48	49	50
23 Construction	36	38	41	41	41	42	43
31-33 Manufacturing	47	46	45	45	45	46	47
42 Wholesale trade	13	13	14	14	14	14	14
44-45 Retail trade	201	205	212	212	212	216	221
48-49 Transportation and warehousing	67	69	73	73	73	74	76
51 Information	21	21	22	22	22	23	23
52 Finance and insurance	54	56	58	58	58	59	61
53 Real estate and rental and leasing	3	3	3	3	3	4	4
54 Professional and technical services	29	31	35	35	35	36	37
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	18	19	21	21	21	22	22
61 Educational services	180	189	201	201	201	206	210
62 Health care and social assistance	217	231	252	252	252	258	263
71 Arts, entertainment, and recreation	0	0	0	0	0	0	0
72 Accommodation and food services	42	44	48	48	48	49	50
81 Other services, except public administration	33	34	36	36	36	37	38
92 Public Administration	86	89	94	94	94	96	98
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	218	226	238	238	238	244	249
Public-Supply Residential Including System Losses (AFY)	928	928	907	907	907	928	948
Self-Supply Residential (AFY)	263	263	257	257	257	263	269
Projection of Irrigated Lands (in Acres)	3,129	3,129	3,129	3,129	3,129	3,129	3,129
Crop Irrigation (AFY)	4,752	4,752	4,752	4,752	4,752	4,752	4,752
Livestock (AFY)	705	713	742	771	800	828	857
Oil and Gas Drilling (AFY)	205	290	427	593	787	1,011	1,263
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**7,069**	**7,172**	**7,324**	**7,518**	**7,741**	**8,025**	**8,337**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Ellis	2007	2010	2020	2030	2040	2050	2060
Population, Total	3,911	3,850	3,749	3,749	3,648	3,648	3,749
Public-Supplied Population	2,531	2,492	2,426	2,426	2,361	2,361	2,426
Self-Supplied Population	1,380	1,359	1,323	1,323	1,287	1,287	1,323
Employment, Total	1,007	1,050	1,109	1,109	1,079	1,079	1,109
11 Agriculture, forestry, fishing and hunting	37	38	38	38	37	37	38
21 Mining, quarrying, and oil and gas extraction	32	33	34	34	33	33	34
22 Utilities	7	7	7	7	7	7	7
23 Construction	15	16	17	17	17	17	17
31-33 Manufacturing	14	14	13	13	13	13	13
42 Wholesale trade	32	33	34	34	33	33	34
44-45 Retail trade	118	120	124	124	120	120	124
48-49 Transportation and warehousing	119	123	128	128	125	125	128
51 Information	4	4	4	4	4	4	4
52 Finance and insurance	35	36	37	37	36	36	37
53 Real estate and rental and leasing	0	0	0	0	0	0	0
54 Professional and technical services	38	42	47	47	45	45	47
55 Management of companies and enterprises	8	8	8	8	8	8	8
56 Administrative and waste services	19	21	23	23	22	22	23
61 Educational services	172	180	191	191	186	186	191
62 Health care and social assistance	116	124	134	134	131	131	134
71 Arts, entertainment, and recreation	23	25	29	29	28	28	29
72 Accommodation and food services	47	49	53	53	52	52	53
81 Other services, except public administration	26	27	28	28	27	27	28
92 Public Administration	145	151	158	158	154	154	158
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	151	158	167	167	163	163	167
Public-Supply Residential Including System Losses (AFY)	587	578	563	563	548	548	563
Self-Supply Residential (AFY)	272	268	261	261	254	254	261
Projection of Irrigated Lands (in Acres)	12,829	13,256	14,680	16,105	17,529	18,622	20,377
Crop Irrigation (AFY)	22,201	22,940	25,405	27,870	30,334	32,225	35,263
Livestock (AFY)	1,377	1,381	1,393	1,405	1,417	1,429	1,441
Oil and Gas Drilling (AFY)	515	774	1,511	2,478	3,675	5,103	6,760
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**25,103**	**26,099**	**29,300**	**32,744**	**36,391**	**39,721**	**44,456**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Garfield	2007	2010	2020	2030	2040	2050	2060
Population, Total	57,657	58,128	59,896	61,369	62,743	63,823	65,100
Public-Supplied Population	56,197	56,656	58,379	59,815	61,154	62,207	63,451
Self-Supplied Population	1,460	1,472	1,517	1,554	1,589	1,616	1,648
Employment, Total	24,152	25,169	26,774	27,432	28,047	28,530	29,100
11 Agriculture, forestry, fishing and hunting	91	92	95	97	99	101	103
21 Mining, quarrying, and oil and gas extraction	819	844	884	906	926	942	961
22 Utilities	222	227	236	241	247	251	256
23 Construction	929	988	1,079	1,106	1,130	1,150	1,173
31-33 Manufacturing	2,777	2,723	2,649	2,714	2,775	2,822	2,879
42 Wholesale trade	1,024	1,051	1,095	1,122	1,147	1,167	1,190
44-45 Retail trade	3,154	3,220	3,329	3,411	3,487	3,547	3,618
48-49 Transportation and warehousing	891	921	969	993	1,015	1,032	1,053
51 Information	309	318	331	340	347	353	360
52 Finance and insurance	779	801	837	857	877	892	909
53 Real estate and rental and leasing	448	472	510	523	534	544	554
54 Professional and technical services	1,782	1,949	2,208	2,262	2,313	2,352	2,399
55 Management of companies and enterprises	62	62	62	63	65	66	67
56 Administrative and waste services	1,605	1,729	1,921	1,968	2,012	2,047	2,088
61 Educational services	1,617	1,693	1,813	1,858	1,900	1,932	1,971
62 Health care and social assistance	3,418	3,640	3,984	4,082	4,173	4,245	4,330
71 Arts, entertainment, and recreation	284	315	362	371	379	386	393
72 Accommodation and food services	1,815	1,918	2,080	2,131	2,179	2,216	2,260
81 Other services, except public administration	753	780	823	843	862	876	894
92 Public Administration	1,373	1,426	1,509	1,546	1,581	1,608	1,640
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	3,611	3,756	3,986	4,084	4,175	4,247	4,332
Public-Supply Residential Including System Losses (AFY)	8,423	8,492	8,750	8,965	9,166	9,324	9,511
Self-Supply Residential (AFY)	186	188	193	198	202	206	210
Projection of Irrigated Lands (in Acres)	5,359	5,359	5,359	5,359	5,359	5,359	5,359
Crop Irrigation (AFY)	6,029	6,029	6,029	6,029	6,029	6,029	6,029
Livestock (AFY)	1,359	1,361	1,368	1,375	1,383	1,390	1,397
Oil and Gas Drilling (AFY)	136	192	283	393	522	671	838
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**19,744**	**20,018**	**20,610**	**21,045**	**21,478**	**21,867**	**22,317**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Garvin	2007	2010	2020	2030	2040	2050	2060
Population, Total	27,141	27,260	27,954	28,449	28,945	29,540	30,135
Public-Supplied Population	22,991	23,092	23,680	24,099	24,519	25,023	25,527
Self-Supplied Population	4,150	4,168	4,274	4,350	4,426	4,517	4,608
Employment, Total	9,007	9,334	9,844	10,019	10,193	10,403	10,612
11 Agriculture, forestry, fishing and hunting	68	69	71	72	73	75	76
21 Mining, quarrying, and oil and gas extraction	957	986	1,032	1,050	1,069	1,091	1,113
22 Utilities	152	155	161	164	167	170	173
23 Construction	506	538	587	598	608	621	633
31-33 Manufacturing	988	969	942	958	975	995	1,015
42 Wholesale trade	297	305	317	323	329	335	342
44-45 Retail trade	1,522	1,554	1,605	1,634	1,662	1,696	1,730
48-49 Transportation and warehousing	227	235	247	251	255	261	266
51 Information	41	43	44	45	46	47	48
52 Finance and insurance	248	255	266	271	276	281	287
53 Real estate and rental and leasing	42	44	48	49	49	50	52
54 Professional and technical services	155	170	192	195	199	203	207
55 Management of companies and enterprises	7	7	7	7	7	7	8
56 Administrative and waste services	133	143	158	161	164	167	171
61 Educational services	329	344	369	375	382	389	397
62 Health care and social assistance	1,515	1,613	1,764	1,795	1,827	1,864	1,902
71 Arts, entertainment, and recreation	34	37	43	44	44	45	46
72 Accommodation and food services	647	684	741	754	767	783	799
81 Other services, except public administration	115	119	126	128	130	133	135
92 Public Administration	1,023	1,062	1,123	1,143	1,163	1,187	1,211
99 Unclassified	1	1	1	1	2	2	2
Public-Supply Nonresidential Including System Losses (AFY)	1,646	1,702	1,791	1,822	1,854	1,892	1,930
Public-Supply Residential Including System Losses (AFY)	3,044	3,058	3,136	3,191	3,247	3,314	3,380
Self-Supply Residential (AFY)	467	469	481	490	498	508	519
Projection of Irrigated Lands (in Acres)	812	909	1,234	1,559	1,884	2,134	2,534
Crop Irrigation (AFY)	1,197	1,340	1,819	2,298	2,777	3,144	3,734
Livestock (AFY)	1,195	1,197	1,203	1,209	1,216	1,222	1,228
Oil and Gas Drilling (AFY)	358	504	710	953	1,233	1,550	1,904
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	230	225	219	223	227	232	236
Total Water Demand, All Sectors (AFY)*	**8,137**	**8,496**	**9,358**	**10,186**	**11,051**	**11,862**	**12,932**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Grady	2007	2010	2020	2030	2040	2050	2060
Population, Total	50,615	51,761	55,473	58,655	61,519	64,382	67,352
Public-Supplied Population	34,875	35,664	38,222	40,415	42,388	44,361	46,407
Self-Supplied Population	15,740	16,096	17,251	18,240	19,131	20,021	20,945
Employment, Total	12,885	13,352	14,145	14,956	15,687	16,417	17,174
11 Agriculture, forestry, fishing and hunting	276	280	288	305	319	334	350
21 Mining, quarrying, and oil and gas extraction	364	375	394	417	437	458	479
22 Utilities	173	177	184	194	204	213	223
23 Construction	888	945	1,036	1,095	1,149	1,202	1,257
31-33 Manufacturing	1,924	1,886	1,842	1,947	2,042	2,137	2,236
42 Wholesale trade	517	531	555	587	615	644	674
44-45 Retail trade	1,749	1,786	1,853	1,959	2,055	2,150	2,249
48-49 Transportation and warehousing	366	378	399	422	443	463	485
51 Information	95	98	103	109	114	119	125
52 Finance and insurance	385	396	415	439	460	482	504
53 Real estate and rental and leasing	146	154	167	176	185	194	203
54 Professional and technical services	258	282	321	339	356	372	390
55 Management of companies and enterprises	19	19	19	20	21	22	23
56 Administrative and waste services	733	790	881	931	976	1,022	1,069
61 Educational services	1,299	1,360	1,462	1,546	1,621	1,697	1,775
62 Health care and social assistance	1,167	1,243	1,366	1,444	1,514	1,585	1,658
71 Arts, entertainment, and recreation	88	98	113	119	125	131	137
72 Accommodation and food services	1,387	1,466	1,595	1,687	1,769	1,851	1,937
81 Other services, except public administration	483	500	530	560	587	615	643
92 Public Administration	567	589	625	661	694	726	759
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	1,986	2,055	2,172	2,297	2,409	2,521	2,638
Public-Supply Residential Including System Losses (AFY)	3,064	3,134	3,358	3,551	3,724	3,898	4,078
Self-Supply Residential (AFY)	1,176	1,202	1,288	1,362	1,429	1,495	1,564
Projection of Irrigated Lands (in Acres)	8,465	8,465	8,465	8,465	8,465	8,465	8,465
Crop Irrigation (AFY)	11,291	11,291	11,291	11,291	11,291	11,291	11,291
Livestock (AFY)	2,158	2,181	2,259	2,336	2,413	2,491	2,568
Oil and Gas Drilling (AFY)	587	828	1,178	1,594	2,076	2,623	3,237
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)		0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**20,262**	**20,691**	**21,547**	**22,432**	**23,343**	**24,320**	**25,375**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Grant	2007	2010	2020	2030	2040	2050	2060
Population, Total	4,497	4,497	4,585	4,673	4,673	4,850	4,938
Public-Supplied Population	3,847	3,847	3,922	3,998	3,998	4,149	4,224
Self-Supplied Population	650	650	663	675	675	701	714
Employment, Total	1,105	1,148	1,217	1,241	1,241	1,288	1,311
11 Agriculture, forestry, fishing and hunting	16	16	17	17	17	18	18
21 Mining, quarrying, and oil and gas extraction	70	72	76	77	77	80	81
22 Utilities	26	27	28	28	28	29	30
23 Construction	62	65	71	73	73	76	77
31-33 Manufacturing	14	14	13	14	14	14	14
42 Wholesale trade	94	96	101	103	103	106	108
44-45 Retail trade	96	98	101	103	103	107	109
48-49 Transportation and warehousing	155	160	169	172	172	178	182
51 Information	11	11	12	12	12	12	13
52 Finance and insurance	67	69	72	73	73	76	77
53 Real estate and rental and leasing	0	0	0	0	0	0	0
54 Professional and technical services	25	27	31	32	32	33	33
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	4	4	5	5	5	5	5
61 Educational services	179	187	201	205	205	213	216
62 Health care and social assistance	61	65	71	73	73	75	77
71 Arts, entertainment, and recreation	0	0	0	0	0	0	0
72 Accommodation and food services	52	55	60	61	61	63	64
81 Other services, except public administration	43	45	47	48	48	50	51
92 Public Administration	131	136	144	147	147	152	155
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	168	175	185	188	188	196	199
Public-Supply Residential Including System Losses (AFY)	542	542	552	563	563	584	595
Self-Supply Residential (AFY)	78	78	80	81	81	84	86
Projection of Irrigated Lands (in Acres)	1,473	1,473	1,473	1,473	1,473	1,473	1,473
Crop Irrigation (AFY)	1,801	1,801	1,801	1,801	1,801	1,801	1,801
Livestock (AFY)	680	689	720	751	782	813	843
Oil and Gas Drilling (AFY)	146	211	338	498	690	915	1,172
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**3,415**	**3,496**	**3,676**	**3,883**	**4,106**	**4,392**	**4,696**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Greer	2007	2010	2020	2030	2040	2050	2060
Population, Total	5,810	5,810	5,810	5,810	5,908	6,007	6,105
Public-Supplied Population	5,810	5,810	5,810	5,810	5,908	6,007	6,105
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	1,492	1,557	1,655	1,655	1,683	1,711	1,739
11 Agriculture, forestry, fishing and hunting	13	13	13	13	14	14	14
21 Mining, quarrying, and oil and gas extraction	36	38	39	39	40	41	41
22 Utilities	24	25	26	26	26	26	27
23 Construction	25	27	29	29	29	30	30
31-33 Manufacturing	46	46	44	44	45	46	46
42 Wholesale trade	24	24	25	25	26	26	27
44-45 Retail trade	176	180	185	185	188	191	195
48-49 Transportation and warehousing	144	149	156	156	159	161	164
51 Information	21	21	22	22	23	23	23
52 Finance and insurance	55	57	59	59	60	61	62
53 Real estate and rental and leasing	7	8	9	9	9	9	9
54 Professional and technical services	14	15	17	17	18	18	18
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	44	48	53	53	54	55	56
61 Educational services	147	154	164	164	167	170	173
62 Health care and social assistance	375	399	436	436	443	450	458
71 Arts, entertainment, and recreation	19	21	25	25	25	25	26
72 Accommodation and food services	39	41	45	45	45	46	47
81 Other services, except public administration	23	24	25	25	25	26	26
92 Public Administration	259	268	283	283	288	293	298
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	187	195	208	208	212	215	219
Public-Supply Residential Including System Losses (AFY)	841	841	841	841	855	870	884
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	3,442	3,860	5,255	6,649	8,043	9,113	10,832
Crop Irrigation (AFY)	5,407	6,064	8,255	10,445	12,636	14,317	17,016
Livestock (AFY)	442	442	442	443	443	444	444
Oil and Gas Drilling (AFY)	4	6	8	10	13	16	19
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**6,881**	**7,548**	**9,754**	**11,947**	**14,159**	**15,861**	**18,582**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Harmon	2007	2010	2020	2030	2040	2050	2060
Population, Total	2,837	2,890	2,890	2,977	3,065	3,152	3,240
Public-Supplied Population	2,837	2,890	2,890	2,977	3,065	3,152	3,240
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	819	855	910	938	965	993	1,020
11 Agriculture, forestry, fishing and hunting	55	56	57	59	60	62	64
21 Mining, quarrying, and oil and gas extraction	0	0	0	0	0	0	0
22 Utilities	20	20	21	22	22	23	24
23 Construction	52	55	60	62	64	66	67
31-33 Manufacturing	21	20	20	20	21	21	22
42 Wholesale trade	21	22	23	23	24	25	25
44-45 Retail trade	66	67	69	72	74	76	78
48-49 Transportation and warehousing	28	29	31	32	33	33	34
51 Information	12	13	13	14	14	14	15
52 Finance and insurance	61	63	65	67	69	71	73
53 Real estate and rental and leasing	0	0	0	0	0	0	0
54 Professional and technical services	9	10	11	11	12	12	12
55 Management of companies and enterprises	13	13	13	13	13	14	14
56 Administrative and waste services	30	32	35	36	38	39	40
61 Educational services	66	69	73	76	78	80	82
62 Health care and social assistance	199	212	231	238	245	253	260
71 Arts, entertainment, and recreation	17	19	22	23	23	24	25
72 Accommodation and food services	36	38	41	42	43	44	46
81 Other services, except public administration	13	14	14	15	15	16	16
92 Public Administration	101	104	110	114	117	120	124
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	105	110	118	121	125	128	132
Public-Supply Residential Including System Losses (AFY)	667	679	679	700	721	741	762
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	17,805	17,955	18,455	18,955	19,454	19,838	20,454
Crop Irrigation (AFY)	26,234	26,455	27,191	27,927	28,664	29,229	30,137
Livestock (AFY)	562	565	577	589	602	614	626
Oil and Gas Drilling (AFY)	2	3	4	5	6	8	9
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**27,569**	**27,812**	**28,569**	**29,343**	**30,117**	**30,720**	**31,665**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Harper	2007	2010	2020	2030	2040	2050	2060
Population, Total	3,254	3,198	3,198	3,198	3,198	3,292	3,292
Public-Supplied Population	2,294	2,254	2,254	2,254	2,254	2,321	2,321
Self-Supplied Population	960	943	943	943	943	971	971
Employment, Total	1,270	1,319	1,393	1,393	1,393	1,434	1,434
11 Agriculture, forestry, fishing and hunting	287	291	298	298	298	306	306
21 Mining, quarrying, and oil and gas extraction	63	65	68	68	68	70	70
22 Utilities	15	15	16	16	16	16	16
23 Construction	37	40	43	43	43	44	44
31-33 Manufacturing	10	10	10	10	10	10	10
42 Wholesale trade	28	29	30	30	30	31	31
44-45 Retail trade	106	108	112	112	112	115	115
48-49 Transportation and warehousing	50	51	54	54	54	55	55
51 Information	6	6	6	6	6	7	7
52 Finance and insurance	25	25	26	26	26	27	27
53 Real estate and rental and leasing	2	2	2	2	2	2	2
54 Professional and technical services	23	25	28	28	28	29	29
55 Management of companies and enterprises	6	6	6	6	6	7	7
56 Administrative and waste services	15	16	18	18	18	18	18
61 Educational services	99	103	110	110	110	114	114
62 Health care and social assistance	269	286	312	312	312	321	321
71 Arts, entertainment, and recreation	9	10	11	11	11	11	11
72 Accommodation and food services	18	19	20	20	20	21	21
81 Other services, except public administration	47	49	51	51	51	53	53
92 Public Administration	156	162	171	171	171	176	176
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	202	210	221	221	221	228	228
Public-Supply Residential Including System Losses (AFY)	765	752	752	752	752	774	774
Self-Supply Residential (AFY)	272	267	267	267	267	275	275
Projection of Irrigated Lands (in Acres)	6,206	6,331	6,748	7,165	7,582	7,902	8,416
Crop Irrigation (AFY)	10,185	10,391	11,075	11,759	12,444	12,969	13,813
Livestock (AFY)	1,439	1,441	1,448	1,456	1,463	1,470	1,478
Oil and Gas Drilling (AFY)	249	356	547	783	1,064	1,389	1,760
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**13,112**	**13,416**	**14,311**	**15,238**	**16,210**	**17,105**	**18,326**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Haskell	2007	2010	2020	2030	2040	2050	2060
Population, Total	12,059	12,561	14,236	16,004	17,865	19,726	21,773
Public-Supplied Population	6,779	7,061	8,003	8,997	10,043	11,089	12,240
Self-Supplied Population	5,280	5,500	6,233	7,007	7,822	8,637	9,533
Employment, Total	3,714	3,895	4,216	4,740	5,291	5,842	6,449
11 Agriculture, forestry, fishing and hunting	56	57	59	66	74	81	90
21 Mining, quarrying, and oil and gas extraction	322	332	351	394	440	486	536
22 Utilities	58	59	62	70	78	86	95
23 Construction	265	282	311	349	390	430	475
31-33 Manufacturing	44	43	42	48	53	59	65
42 Wholesale trade	94	96	101	114	127	141	155
44-45 Retail trade	438	447	466	524	585	646	713
48-49 Transportation and warehousing	94	97	103	116	129	143	158
51 Information	24	25	26	29	33	36	40
52 Finance and insurance	63	65	68	77	85	94	104
53 Real estate and rental and leasing	3	3	4	4	5	5	6
54 Professional and technical services	70	77	88	98	110	121	134
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	117	126	141	159	177	196	216
61 Educational services	386	404	437	491	548	605	668
62 Health care and social assistance	1,271	1,353	1,495	1,680	1,876	2,071	2,286
71 Arts, entertainment, and recreation	25	28	32	36	40	45	49
72 Accommodation and food services	119	126	138	155	173	191	210
81 Other services, except public administration	24	25	26	30	33	37	40
92 Public Administration	240	249	266	299	334	369	407
99 Unclassified	1	1	1	1	1	1	2
Public-Supply Nonresidential Including System Losses (AFY)	595	621	669	753	840	928	1,024
Public-Supply Residential Including System Losses (AFY)	675	703	797	896	1,000	1,104	1,219
Self-Supply Residential (AFY)	447	465	528	593	662	731	807
Projection of Irrigated Lands (in Acres)	1,703	1,745	1,886	2,027	2,167	2,276	2,449
Crop Irrigation (AFY)	2,526	2,589	2,798	3,006	3,215	3,375	3,633
Livestock (AFY)	1,163	1,167	1,179	1,191	1,203	1,215	1,227
Oil and Gas Drilling (AFY)	708	1,080	2,223	3,735	5,615	7,864	10,481
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**6,114**	**6,625**	**8,193**	**10,174**	**12,535**	**15,217**	**18,391**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Hughes	2007	2010	2020	2030	2040	2050	2060
Population, Total	13,680	14,167	15,792	17,416	19,130	21,025	22,920
Public-Supplied Population	12,740	13,194	14,706	16,219	17,816	19,581	21,345
Self-Supplied Population	940	973	1,085	1,197	1,315	1,445	1,575
Employment, Total	2,847	2,972	3,196	3,525	3,872	4,255	4,639
11 Agriculture, forestry, fishing and hunting	37	38	39	43	47	52	56
21 Mining, quarrying, and oil and gas extraction	60	62	65	72	79	87	95
22 Utilities	28	28	30	33	36	40	43
23 Construction	74	79	87	96	105	116	126
31-33 Manufacturing	224	220	215	238	261	287	313
42 Wholesale trade	53	54	57	63	69	76	83
44-45 Retail trade	316	323	336	371	408	448	488
48-49 Transportation and warehousing	116	120	127	140	154	169	185
51 Information	42	43	46	50	55	61	66
52 Finance and insurance	94	97	102	112	123	136	148
53 Real estate and rental and leasing	59	62	68	75	82	90	98
54 Professional and technical services	23	25	29	32	35	38	42
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	251	270	302	334	366	403	439
61 Educational services	411	430	465	513	563	619	675
62 Health care and social assistance	584	622	687	757	832	914	996
71 Arts, entertainment, and recreation	47	52	61	67	74	81	88
72 Accommodation and food services	130	137	150	165	182	200	218
81 Other services, except public administration	9	9	10	11	12	13	14
92 Public Administration	289	300	321	354	388	427	465
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	395	412	443	489	537	590	644
Public-Supply Residential Including System Losses (AFY)	1,327	1,374	1,531	1,689	1,855	2,039	2,223
Self-Supply Residential (AFY)	83	86	96	106	116	128	139
Projection of Irrigated Lands (in Acres)	2,244	2,479	3,262	4,045	4,829	5,430	6,395
Crop Irrigation (AFY)	2,973	3,285	4,323	5,360	6,398	7,195	8,474
Livestock (AFY)	1,649	1,654	1,673	1,691	1,709	1,727	1,745
Oil and Gas Drilling (AFY)	2,194	3,185	6,141	4,365	3,320	1,886	62
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**8,620**	**9,997**	**14,207**	**13,700**	**13,935**	**13,564**	**13,286**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Jackson	2007	2010	2020	2030	2040	2050	2060
Population, Total	25,778	26,249	27,819	29,127	30,173	31,045	31,743
Public-Supplied Population	24,698	25,149	26,653	27,906	28,909	29,745	30,413
Self-Supplied Population	1,080	1,100	1,165	1,220	1,264	1,301	1,330
Employment, Total	10,886	11,293	11,972	12,535	12,985	13,361	13,661
11 Agriculture, forestry, fishing and hunting	494	501	515	539	558	575	587
21 Mining, quarrying, and oil and gas extraction	40	42	44	46	48	49	50
22 Utilities	108	111	115	120	125	128	131
23 Construction	165	175	192	201	208	214	219
31-33 Manufacturing	901	883	862	902	935	962	983
42 Wholesale trade	264	271	283	296	307	315	323
44-45 Retail trade	1,425	1,455	1,508	1,579	1,636	1,683	1,721
48-49 Transportation and warehousing	618	639	674	706	731	752	769
51 Information	100	102	107	112	116	119	122
52 Finance and insurance	236	243	254	266	276	284	290
53 Real estate and rental and leasing	68	72	78	81	84	87	89
54 Professional and technical services	159	174	197	207	214	220	225
55 Management of companies and enterprises	106	105	105	110	114	117	120
56 Administrative and waste services	386	416	463	485	502	517	529
61 Educational services	1,530	1,602	1,721	1,802	1,866	1,920	1,963
62 Health care and social assistance	952	1,014	1,113	1,165	1,207	1,242	1,270
71 Arts, entertainment, and recreation	74	82	95	99	103	106	108
72 Accommodation and food services	1,178	1,245	1,354	1,417	1,468	1,510	1,544
81 Other services, except public administration	179	185	196	205	213	219	224
92 Public Administration	1,903	1,976	2,097	2,196	2,275	2,341	2,393
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	1,545	1,605	1,704	1,784	1,848	1,902	1,945
Public-Supply Residential Including System Losses (AFY)	2,960	3,015	3,195	3,345	3,465	3,565	3,645
Self-Supply Residential (AFY)	110	112	119	124	129	133	135
Projection of Irrigated Lands (in Acres)	55,120	55,455	56,572	57,689	58,806	59,663	61,040
Crop Irrigation (AFY)	101,101	101,716	103,765	105,813	107,862	109,434	111,960
Livestock (AFY)	576	592	646	701	755	809	864
Oil and Gas Drilling (AFY)	19	29	60	100	151	211	280
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	613	601	586	614	636	654	669
Total Water Demand, All Sectors (AFY)*	**106,924**	**107,669**	**110,075**	**112,482**	**114,846**	**116,708**	**119,498**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Jefferson	2007	2010	2020	2030	2040	2050	2060
Population, Total	6,273	6,273	6,368	6,463	6,558	6,748	6,938
Public-Supplied Population	6,133	6,133	6,226	6,319	6,412	6,598	6,783
Self-Supplied Population	140	140	142	144	146	151	155
Employment, Total	1,249	1,299	1,377	1,398	1,418	1,459	1,501
11 Agriculture, forestry, fishing and hunting	42	43	44	44	45	46	48
21 Mining, quarrying, and oil and gas extraction	12	12	13	13	13	14	14
22 Utilities	0	0	0	0	0	0	0
23 Construction	35	38	41	42	42	44	45
31-33 Manufacturing	79	77	75	76	78	80	82
42 Wholesale trade	55	56	59	60	61	62	64
44-45 Retail trade	160	163	169	171	174	179	184
48-49 Transportation and warehousing	59	61	64	65	66	68	70
51 Information	11	11	12	12	12	13	13
52 Finance and insurance	81	83	87	88	90	92	95
53 Real estate and rental and leasing	6	6	7	7	7	7	7
54 Professional and technical services	32	35	39	40	40	41	43
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	6	6	7	7	7	8	8
61 Educational services	197	206	220	224	227	234	240
62 Health care and social assistance	240	256	280	284	289	297	305
71 Arts, entertainment, and recreation	0	0	0	0	0	0	0
72 Accommodation and food services	58	61	66	67	68	70	72
81 Other services, except public administration	46	48	50	51	52	53	55
92 Public Administration	130	135	143	145	147	151	156
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	167	173	183	186	189	194	200
Public-Supply Residential Including System Losses (AFY)	603	603	612	621	630	649	667
Self-Supply Residential (AFY)	12	12	12	12	12	13	13
Projection of Irrigated Lands (in Acres)	330	339	369	399	428	451	488
Crop Irrigation (AFY)	354	363	395	427	459	484	523
Livestock (AFY)	1,296	1,297	1,301	1,305	1,310	1,314	1,318
Oil and Gas Drilling (AFY)	26	36	50	65	83	103	125
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**2,457**	**2,484**	**2,553**	**2,617**	**2,683**	**2,756**	**2,845**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Johnston	2007	2010	2020	2030	2040	2050	2060
Population, Total	10,402	10,735	12,031	13,419	14,807	16,288	17,861
Public-Supplied Population	10,292	10,622	11,904	13,277	14,651	16,116	17,672
Self-Supplied Population	110	114	127	142	157	172	189
Employment, Total	2,968	3,060	3,232	3,605	3,978	4,376	4,799
11 Agriculture, forestry, fishing and hunting	15	15	16	18	19	21	23
21 Mining, quarrying, and oil and gas extraction	105	108	114	127	141	155	170
22 Utilities	33	33	35	39	43	47	52
23 Construction	21	22	24	27	30	33	36
31-33 Manufacturing	717	703	689	769	848	933	1,023
42 Wholesale trade	154	158	166	185	204	225	246
44-45 Retail trade	234	239	249	278	307	337	370
48-49 Transportation and warehousing	55	56	60	67	74	81	89
51 Information	19	20	21	23	25	28	31
52 Finance and insurance	28	29	31	34	38	42	46
53 Real estate and rental and leasing	4	5	5	6	6	7	7
54 Professional and technical services	37	41	46	52	57	63	69
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	32	35	39	43	48	53	58
61 Educational services	378	395	427	476	525	578	634
62 Health care and social assistance	698	744	820	915	1,010	1,111	1,218
71 Arts, entertainment, and recreation	11	13	15	16	18	20	22
72 Accommodation and food services	77	82	89	100	110	121	133
81 Other services, except public administration	59	61	65	72	80	88	96
92 Public Administration	290	301	321	358	395	435	477
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	470	483	507	566	624	686	753
Public-Supply Residential Including System Losses (AFY)	1,264	1,305	1,462	1,631	1,799	1,979	2,171
Self-Supply Residential (AFY)	11	12	13	15	16	18	20
Projection of Irrigated Lands (in Acres)	692	760	989	1,217	1,445	1,621	1,902
Crop Irrigation (AFY)	1,333	1,464	1,904	2,344	2,783	3,121	3,662
Livestock (AFY)	619	622	631	640	649	658	667
Oil and Gas Drilling (AFY)	61	96	220	387	596	846	1,140
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	1,425	1,397	1,359	1,380	1,400	1,440	1,481
Total Water Demand, All Sectors (AFY)*	**5,183**	**5,378**	**6,097**	**6,961**	**7,867**	**8,749**	**9,893**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Kay	2007	2010	2020	2030	2040	2050	2060
Population, Total	45,638	45,975	47,567	48,784	49,908	51,031	52,249
Public-Supplied Population	43,398	43,719	45,232	46,390	47,458	48,527	49,684
Self-Supplied Population	2,240	2,257	2,335	2,394	2,450	2,505	2,564
Employment, Total	19,688	20,464	21,697	22,253	22,765	23,278	23,833
11 Agriculture, forestry, fishing and hunting	8	8	8	9	9	9	9
21 Mining, quarrying, and oil and gas extraction	1,107	1,141	1,195	1,226	1,254	1,282	1,313
22 Utilities	239	245	253	260	266	272	278
23 Construction	1,058	1,125	1,229	1,261	1,290	1,319	1,350
31-33 Manufacturing	2,807	2,752	2,678	2,746	2,810	2,873	2,941
42 Wholesale trade	543	557	581	596	609	623	638
44-45 Retail trade	2,211	2,257	2,334	2,394	2,449	2,504	2,564
48-49 Transportation and warehousing	694	718	755	775	793	810	830
51 Information	398	409	426	437	447	458	468
52 Finance and insurance	480	494	516	529	541	553	566
53 Real estate and rental and leasing	220	232	251	257	263	269	276
54 Professional and technical services	746	816	925	948	970	992	1,016
55 Management of companies and enterprises	99	98	98	101	103	105	108
56 Administrative and waste services	1,398	1,506	1,673	1,716	1,756	1,795	1,838
61 Educational services	1,853	1,940	2,078	2,131	2,180	2,229	2,283
62 Health care and social assistance	2,188	2,330	2,551	2,616	2,676	2,736	2,802
71 Arts, entertainment, and recreation	460	510	586	601	615	629	644
72 Accommodation and food services	1,490	1,575	1,708	1,751	1,792	1,832	1,876
81 Other services, except public administration	589	610	644	660	675	690	707
92 Public Administration	1,084	1,126	1,192	1,222	1,250	1,279	1,309
99 Unclassified	16	16	16	16	17	17	18
Public-Supply Nonresidential Including System Losses (AFY)	3,345	3,477	3,685	3,779	3,866	3,953	4,048
Public-Supply Residential Including System Losses (AFY)	4,203	4,234	4,381	4,493	4,597	4,700	4,812
Self-Supply Residential (AFY)	184	186	192	197	202	206	211
Projection of Irrigated Lands (in Acres)	3,569	3,569	3,569	3,569	3,569	3,569	3,569
Crop Irrigation (AFY)	4,690	4,690	4,690	4,690	4,690	4,690	4,690
Livestock (AFY)	612	618	635	652	670	687	705
Oil and Gas Drilling (AFY)	115	161	220	289	366	453	550
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	11,004	11,340	11,880	12,184	12,465	12,746	13,050
Total Water Demand, All Sectors (AFY)*	**24,155**	**24,705**	**25,684**	**26,285**	**26,856**	**27,436**	**28,065**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Kingfisher	2007	2010	2020	2030	2040	2050	2060
Population, Total	14,320	14,784	16,523	18,262	20,002	21,741	23,673
Public-Supplied Population	10,310	10,644	11,896	13,148	14,401	15,653	17,044
Self-Supplied Population	4,010	4,140	4,627	5,114	5,601	6,088	6,629
Employment, Total	5,908	6,090	6,431	7,108	7,785	8,462	9,215
11 Agriculture, forestry, fishing and hunting	41	42	43	47	52	57	62
21 Mining, quarrying, and oil and gas extraction	750	773	816	902	987	1,073	1,169
22 Utilities	54	55	57	63	69	75	82
23 Construction	329	349	385	425	466	506	551
31-33 Manufacturing	1,145	1,123	1,100	1,216	1,332	1,448	1,577
42 Wholesale trade	237	243	255	282	309	336	366
44-45 Retail trade	627	640	667	737	807	877	955
48-49 Transportation and warehousing	250	259	274	303	332	361	393
51 Information	77	79	83	92	101	110	119
52 Finance and insurance	185	190	200	221	242	263	287
53 Real estate and rental and leasing	70	74	80	89	97	106	115
54 Professional and technical services	114	125	142	157	172	187	204
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	105	113	126	140	153	166	181
61 Educational services	637	667	719	795	871	947	1,031
62 Health care and social assistance	442	470	519	573	628	683	743
71 Arts, entertainment, and recreation	48	53	62	68	75	81	88
72 Accommodation and food services	394	417	455	503	551	599	652
81 Other services, except public administration	177	183	195	215	236	256	279
92 Public Administration	227	236	251	278	304	331	360
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	1,219	1,255	1,324	1,463	1,603	1,742	1,897
Public-Supply Residential Including System Losses (AFY)	1,620	1,672	1,869	2,066	2,263	2,459	2,678
Self-Supply Residential (AFY)	536	553	618	683	748	813	885
Projection of Irrigated Lands (in Acres)	5,527	5,611	5,891	6,170	6,450	6,664	7,009
Crop Irrigation (AFY)	7,808	7,926	8,321	8,716	9,111	9,415	9,902
Livestock (AFY)	2,193	2,198	2,215	2,231	2,248	2,265	2,282
Oil and Gas Drilling (AFY)	153	217	316	436	577	739	921
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**13,528**	**13,821**	**14,663**	**15,597**	**16,550**	**17,433**	**18,564**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Kiowa	2007	2010	2020	2030	2040	2050	2060
Population, Total	9,456	9,399	9,399	9,494	9,589	9,779	9,969
Public-Supplied Population	9,456	9,399	9,399	9,494	9,589	9,779	9,969
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	2,429	2,540	2,706	2,733	2,760	2,815	2,870
11 Agriculture, forestry, fishing and hunting	29	29	30	30	30	31	31
21 Mining, quarrying, and oil and gas extraction	151	156	163	164	166	169	172
22 Utilities	37	38	39	40	40	41	42
23 Construction	68	73	79	80	81	82	84
31-33 Manufacturing	76	75	72	73	74	75	77
42 Wholesale trade	100	103	107	108	109	111	113
44-45 Retail trade	247	252	260	263	265	270	276
48-49 Transportation and warehousing	75	78	81	82	83	85	86
51 Information	28	29	30	30	30	31	32
52 Finance and insurance	88	90	94	95	96	98	100
53 Real estate and rental and leasing	8	8	9	9	9	9	10
54 Professional and technical services	47	51	58	59	59	60	62
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	13	14	16	16	16	16	17
61 Educational services	201	211	225	227	229	234	238
62 Health care and social assistance	765	815	889	898	907	925	943
71 Arts, entertainment, and recreation	42	47	54	54	55	56	57
72 Accommodation and food services	94	100	108	109	110	112	114
81 Other services, except public administration	120	124	131	132	133	136	139
92 Public Administration	239	248	262	264	267	272	278
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	408	426	454	459	463	472	481
Public-Supply Residential Including System Losses (AFY)	825	820	820	829	837	853	870
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	2,615	2,637	2,709	2,782	2,854	2,910	2,999
Crop Irrigation (AFY)	4,525	4,563	4,688	4,813	4,939	5,035	5,190
Livestock (AFY)	1,080	1,082	1,092	1,101	1,110	1,119	1,129
Oil and Gas Drilling (AFY)	39	55	75	99	125	155	188
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**6,877**	**6,946**	**7,129**	**7,300**	**7,474**	**7,635**	**7,857**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Latimer	2007	2010	2020	2030	2040	2050	2060
Population, Total	10,508	10,624	11,107	11,686	12,362	13,038	13,811
Public-Supplied Population	9,188	9,289	9,712	10,218	10,809	11,401	12,076
Self-Supplied Population	1,320	1,335	1,395	1,468	1,553	1,638	1,735
Employment, Total	3,870	4,058	4,362	4,590	4,856	5,121	5,425
11 Agriculture, forestry, fishing and hunting	15	15	16	17	18	18	20
21 Mining, quarrying, and oil and gas extraction	285	294	308	324	343	362	383
22 Utilities	83	85	88	93	98	103	110
23 Construction	205	218	238	251	265	280	296
31-33 Manufacturing	136	134	130	137	145	153	162
42 Wholesale trade	82	84	88	92	98	103	109
44-45 Retail trade	248	254	263	276	292	308	327
48-49 Transportation and warehousing	31	32	34	36	38	40	42
51 Information	16	17	17	18	19	21	22
52 Finance and insurance	52	53	56	59	62	66	70
53 Real estate and rental and leasing	43	45	49	52	55	58	61
54 Professional and technical services	22	24	27	29	30	32	34
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	105	113	126	133	140	148	157
61 Educational services	690	723	776	816	863	910	964
62 Health care and social assistance	1,231	1,311	1,438	1,513	1,600	1,688	1,788
71 Arts, entertainment, and recreation	68	76	87	92	97	102	108
72 Accommodation and food services	156	165	179	188	199	210	223
81 Other services, except public administration	7	7	8	8	9	9	10
92 Public Administration	391	406	431	453	479	505	535
99 Unclassified	3	3	3	4	4	4	4
Public-Supply Nonresidential Including System Losses (AFY)	654	685	734	773	817	862	913
Public-Supply Residential Including System Losses (AFY)	1,558	1,576	1,647	1,733	1,833	1,934	2,048
Self-Supply Residential (AFY)	190	192	201	212	224	236	250
Projection of Irrigated Lands (in Acres)	439	533	847	1,161	1,474	1,715	2,102
Crop Irrigation (AFY)	698	848	1,347	1,846	2,346	2,729	3,344
Livestock (AFY)	570	571	576	580	584	588	593
Oil and Gas Drilling (AFY)	367	521	770	1,072	1,427	1,836	2,297
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**4,038**	**4,393**	**5,276**	**6,216**	**7,232**	**8,185**	**9,445**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Le Flore	2007	2010	2020	2030	2040	2050	2060
Population, Total	49,715	50,780	54,724	58,274	61,823	65,373	69,120
Public-Supplied Population	43,355	44,284	47,723	50,819	53,914	57,010	60,277
Self-Supplied Population	6,360	6,496	7,001	7,455	7,909	8,363	8,842
Employment, Total	12,767	13,211	13,977	14,883	15,790	16,697	17,654
11 Agriculture, forestry, fishing and hunting	116	118	121	129	137	145	153
21 Mining, quarrying, and oil and gas extraction	774	798	839	893	948	1,002	1,060
22 Utilities	115	118	122	130	138	146	155
23 Construction	441	469	514	548	581	614	649
31-33 Manufacturing	2,324	2,278	2,226	2,371	2,515	2,659	2,812
42 Wholesale trade	196	201	210	224	238	251	266
44-45 Retail trade	1,563	1,596	1,657	1,764	1,872	1,979	2,093
48-49 Transportation and warehousing	284	294	310	330	350	371	392
51 Information	71	73	76	81	86	91	97
52 Finance and insurance	364	374	393	418	444	469	496
53 Real estate and rental and leasing	47	50	54	57	61	64	68
54 Professional and technical services	258	282	321	342	362	383	405
55 Management of companies and enterprises	25	25	25	27	29	30	32
56 Administrative and waste services	570	614	685	730	774	819	865
61 Educational services	1,628	1,705	1,833	1,952	2,071	2,190	2,316
62 Health care and social assistance	2,259	2,406	2,645	2,816	2,988	3,159	3,340
71 Arts, entertainment, and recreation	35	39	45	47	50	53	56
72 Accommodation and food services	596	630	686	730	775	819	866
81 Other services, except public administration	195	202	214	228	242	256	270
92 Public Administration	904	939	998	1,063	1,127	1,192	1,260
99 Unclassified	2	2	2	2	2	2	3
Public-Supply Nonresidential Including System Losses (AFY)	2,087	2,151	2,263	2,410	2,557	2,704	2,859
Public-Supply Residential Including System Losses (AFY)	4,342	4,435	4,779	5,089	5,399	5,709	6,037
Self-Supply Residential (AFY)	541	553	596	635	673	712	753
Projection of Irrigated Lands (in Acres)	9,398	9,398	9,398	9,398	9,398	9,398	9,398
Crop Irrigation (AFY)	9,985	9,985	9,985	9,985	9,985	9,985	9,985
Livestock (AFY)	2,494	2,499	2,517	2,535	2,553	2,571	2,588
Oil and Gas Drilling (AFY)	634	969	2,009	3,386	5,100	7,151	9,538
Thermoelectric, Withdrawals (AFY)	5,695	5,885	6,565	7,324	8,171	9,116	10,170
Thermoelectric, Consumptive Use (AFY)	3,527	3,645	4,066	4,536	5,061	5,646	6,299
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**25,779**	**26,477**	**28,716**	**31,365**	**34,439**	**37,947**	**41,929**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Lincoln	2007	2010	2020	2030	2040	2050	2060
Population, Total	32,272	33,073	36,027	38,505	41,079	43,747	46,607
Public-Supplied Population	14,622	14,985	16,323	17,446	18,612	19,821	21,117
Self-Supplied Population	17,650	18,088	19,704	21,059	22,466	23,926	25,490
Employment, Total	7,085	7,390	7,911	8,455	9,020	9,606	10,234
11 Agriculture, forestry, fishing and hunting	8	8	8	9	10	10	11
21 Mining, quarrying, and oil and gas extraction	91	94	99	106	113	120	128
22 Utilities	14	14	15	16	17	18	19
23 Construction	514	547	600	642	684	729	777
31-33 Manufacturing	566	555	543	580	619	659	702
42 Wholesale trade	143	147	154	165	176	187	199
44-45 Retail trade	632	645	670	717	764	814	867
48-49 Transportation and warehousing	440	455	481	515	549	585	623
51 Information	35	36	37	40	43	45	48
52 Finance and insurance	513	528	554	592	631	672	716
53 Real estate and rental and leasing	51	54	58	62	67	71	76
54 Professional and technical services	137	150	171	182	195	207	221
55 Management of companies and enterprises	9	9	9	10	10	11	12
56 Administrative and waste services	118	127	142	152	162	172	183
61 Educational services	782	819	881	942	1,005	1,070	1,140
62 Health care and social assistance	1,562	1,663	1,830	1,956	2,086	2,222	2,367
71 Arts, entertainment, and recreation	49	54	63	67	72	76	81
72 Accommodation and food services	581	614	669	715	763	812	866
81 Other services, except public administration	101	105	111	119	126	135	143
92 Public Administration	734	763	811	867	925	985	1,050
99 Unclassified	4	4	4	4	4	4	5
Public-Supply Nonresidential Including System Losses (AFY)	976	1,018	1,089	1,164	1,241	1,322	1,408
Public-Supply Residential Including System Losses (AFY)	1,325	1,358	1,479	1,581	1,687	1,797	1,914
Self-Supply Residential (AFY)	1,360	1,393	1,518	1,622	1,731	1,843	1,964
Projection of Irrigated Lands (in Acres)	2,191	2,191	2,191	2,191	2,191	2,191	2,191
Crop Irrigation (AFY)	3,575	3,575	3,575	3,575	3,575	3,575	3,575
Livestock (AFY)	1,117	1,118	1,119	1,121	1,122	1,124	1,125
Oil and Gas Drilling (AFY)	331	491	904	1,442	2,103	2,888	3,797
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**8,684**	**8,953**	**9,685**	**10,505**	**11,459**	**12,549**	**13,783**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Logan	2007	2010	2020	2030	2040	2050	2060
Population, Total	36,435	37,843	42,537	46,742	50,946	55,053	59,454
Public-Supplied Population	25,175	26,148	29,391	32,296	35,202	38,040	41,080
Self-Supplied Population	11,260	11,695	13,146	14,445	15,745	17,014	18,374
Employment, Total	6,690	7,013	7,581	8,331	9,080	9,812	10,596
11 Agriculture, forestry, fishing and hunting	119	121	125	137	149	161	174
21 Mining, quarrying, and oil and gas extraction	102	105	111	122	133	144	155
22 Utilities	44	45	47	51	56	60	65
23 Construction	506	538	593	652	710	768	829
31-33 Manufacturing	309	303	297	327	356	385	415
42 Wholesale trade	139	143	150	165	179	194	209
44-45 Retail trade	809	826	861	946	1,031	1,114	1,203
48-49 Transportation and warehousing	397	411	436	479	522	564	609
51 Information	36	37	39	43	47	51	55
52 Finance and insurance	227	233	246	270	294	318	344
53 Real estate and rental and leasing	68	72	78	86	94	101	109
54 Professional and technical services	439	481	549	603	657	710	767
55 Management of companies and enterprises	26	25	25	28	31	33	36
56 Administrative and waste services	317	341	382	420	458	495	534
61 Educational services	651	682	736	809	881	952	1,029
62 Health care and social assistance	1,176	1,253	1,382	1,519	1,656	1,789	1,932
71 Arts, entertainment, and recreation	188	209	242	266	290	313	338
72 Accommodation and food services	525	555	607	666	726	785	848
81 Other services, except public administration	137	142	151	166	181	195	211
92 Public Administration	472	490	523	575	626	677	731
99 Unclassified	2	2	2	2	2	3	3
Public-Supply Nonresidential Including System Losses (AFY)	955	1,005	1,091	1,199	1,306	1,412	1,525
Public-Supply Residential Including System Losses (AFY)	3,651	3,792	4,263	4,684	5,106	5,517	5,958
Self-Supply Residential (AFY)	1,388	1,442	1,621	1,781	1,941	2,097	2,265
Projection of Irrigated Lands (in Acres)	1,600	1,600	1,600	1,600	1,600	1,600	1,600
Crop Irrigation (AFY)	1,991	1,991	1,991	1,991	1,991	1,991	1,991
Livestock (AFY)	728	742	789	837	884	931	978
Oil and Gas Drilling (AFY)	269	396	694	1,078	1,548	2,103	2,744
Thermoelectric, Withdrawals (AFY)	242	250	279	312	348	388	433
Thermoelectric, Consumptive Use (AFY)	150	155	173	193	215	240	268
Self-Supply Large Industry (AFY)	1,200	1,176	1,154	1,268	1,382	1,493	1,612
Total Water Demand, All Sectors (AFY)*	**10,425**	**10,794**	**11,882**	**13,149**	**14,505**	**15,932**	**17,506**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Love	2007	2010	2020	2030	2040	2050	2060
Population, Total	9,112	9,606	25,223	26,778	28,425	30,163	31,901
Public-Supplied Population	8,802	9,279	24,365	25,867	27,458	29,137	30,816
Self-Supplied Population	310	327	858	911	967	1,026	1,085
Employment, Total	3,370	3,531	9,875	10,484	11,129	11,809	12,490
11 Agriculture, forestry, fishing and hunting	56	57	66	70	75	79	84
21 Mining, quarrying, and oil and gas extraction	106	110	130	138	146	155	164
22 Utilities	98	100	117	124	132	140	148
23 Construction	273	290	358	380	404	428	453
31-33 Manufacturing	254	249	274	291	309	328	347
42 Wholesale trade	140	144	169	180	191	202	214
44-45 Retail trade	150	153	779	827	877	931	985
48-49 Transportation and warehousing	58	60	71	76	80	85	90
51 Information	36	37	44	47	49	52	55
52 Finance and insurance	40	41	49	52	55	58	61
53 Real estate and rental and leasing	55	58	71	75	80	85	89
54 Professional and technical services	23	25	32	34	36	38	41
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	8	9	11	11	12	13	14
61 Educational services	387	405	490	520	552	586	620
62 Health care and social assistance	1,094	1,165	1,440	1,529	1,623	1,722	1,822
71 Arts, entertainment, and recreation	127	141	2,183	2,318	2,461	2,611	2,762
72 Accommodation and food services	291	307	3,376	3,585	3,805	4,038	4,271
81 Other services, except public administration	25	26	31	33	35	37	39
92 Public Administration	148	154	184	195	207	220	232
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	548	576	2,648	2,811	2,984	3,166	3,349
Public-Supply Residential Including System Losses (AFY)	900	948	2,490	2,643	2,806	2,978	3,149
Self-Supply Residential (AFY)	27	28	75	79	84	89	94
Projection of Irrigated Lands (in Acres)	1,838	1,940	2,280	2,619	2,959	3,219	3,638
Crop Irrigation (AFY)	2,593	2,737	3,216	3,695	4,174	4,542	5,133
Livestock (AFY)	655	655	655	655	655	655	655
Oil and Gas Drilling (AFY)	30	43	58	77	97	120	146
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**4,753**	**4,987**	**9,142**	**9,961**	**10,801**	**11,551**	**12,526**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Major	2007	2010	2020	2030	2040	2050	2060
Population, Total	7,190	7,132	7,229	7,229	7,325	7,421	7,518
Public-Supplied Population	5,100	5,059	5,127	5,127	5,196	5,264	5,332
Self-Supplied Population	2,090	2,073	2,101	2,101	2,129	2,157	2,185
Employment, Total	2,260	2,352	2,491	2,491	2,524	2,557	2,590
11 Agriculture, forestry, fishing and hunting	58	59	60	60	61	62	63
21 Mining, quarrying, and oil and gas extraction	283	291	304	304	308	312	316
22 Utilities	40	41	43	43	43	44	44
23 Construction	148	157	171	171	173	176	178
31-33 Manufacturing	104	102	99	99	100	102	103
42 Wholesale trade	118	121	126	126	127	129	131
44-45 Retail trade	280	286	295	295	299	303	306
48-49 Transportation and warehousing	106	110	115	115	116	118	120
51 Information	10	10	11	11	11	11	11
52 Finance and insurance	88	90	94	94	96	97	98
53 Real estate and rental and leasing	11	12	12	12	13	13	13
54 Professional and technical services	62	68	77	77	78	79	80
55 Management of companies and enterprises	19	19	18	18	19	19	19
56 Administrative and waste services	143	154	171	171	173	176	178
61 Educational services	190	199	213	213	215	218	221
62 Health care and social assistance	302	321	351	351	355	360	365
71 Arts, entertainment, and recreation	0	0	0	0	0	0	0
72 Accommodation and food services	113	119	129	129	131	133	134
81 Other services, except public administration	30	31	33	33	33	34	34
92 Public Administration	151	157	165	165	168	170	172
99 Unclassified	4	4	4	4	4	4	4
Public-Supply Nonresidential Including System Losses (AFY)	394	408	430	430	436	441	447
Public-Supply Residential Including System Losses (AFY)	580	576	584	584	591	599	607
Self-Supply Residential (AFY)	208	206	209	209	212	215	217
Projection of Irrigated Lands (in Acres)	8,169	8,177	8,205	8,233	8,261	8,282	8,316
Crop Irrigation (AFY)	13,020	13,033	13,078	13,122	13,166	13,200	13,254
Livestock (AFY)	1,937	1,944	1,967	1,990	2,013	2,036	2,060
Oil and Gas Drilling (AFY)	451	635	889	1,187	1,531	1,918	2,351
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**16,591**	**16,802**	**17,156**	**17,522**	**17,949**	**18,410**	**18,936**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Marshall	2007	2010	2020	2030	2040	2050	2060
Population, Total	14,830	15,903	19,573	23,337	27,195	31,241	35,475
Public-Supplied Population	14,180	15,206	18,715	22,314	26,003	29,872	33,920
Self-Supplied Population	650	697	858	1,023	1,192	1,369	1,555
Employment, Total	4,308	4,426	7,490	8,930	10,406	11,954	13,575
11 Agriculture, forestry, fishing and hunting	8	8	8	10	11	13	15
21 Mining, quarrying, and oil and gas extraction	43	45	47	57	66	76	86
22 Utilities	27	27	29	34	40	46	52
23 Construction	53	56	62	74	87	100	113
31-33 Manufacturing	1,303	1,277	1,262	1,505	1,754	2,015	2,288
42 Wholesale trade	284	292	308	368	429	492	559
44-45 Retail trade	430	439	761	908	1,058	1,215	1,380
48-49 Transportation and warehousing	65	67	72	85	100	114	130
51 Information	8	8	9	11	12	14	16
52 Finance and insurance	194	200	212	252	294	338	384
53 Real estate and rental and leasing	40	42	46	55	64	74	84
54 Professional and technical services	59	65	74	89	103	119	135
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	45	48	54	65	75	87	98
61 Educational services	175	183	199	237	277	318	361
62 Health care and social assistance	802	854	950	1,132	1,319	1,516	1,721
71 Arts, entertainment, and recreation	109	121	1,141	1,360	1,585	1,821	2,068
72 Accommodation and food services	291	308	1,839	2,192	2,555	2,935	3,333
81 Other services, except public administration	31	32	34	40	47	54	61
92 Public Administration	342	355	382	455	530	609	692
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	679	698	1,715	2,044	2,382	2,737	3,108
Public-Supply Residential Including System Losses (AFY)	1,454	1,559	1,919	2,288	2,666	3,063	3,478
Self-Supply Residential (AFY)	57	61	75	89	104	119	136
Projection of Irrigated Lands (in Acres)	2,254	2,276	2,348	2,421	2,493	2,549	2,638
Crop Irrigation (AFY)	4,611	4,655	4,804	4,952	5,100	5,214	5,397
Livestock (AFY)	307	312	328	344	359	375	391
Oil and Gas Drilling (AFY)	299	434	836	594	452	257	8
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**7,406**	**7,719**	**9,676**	**10,312**	**11,064**	**11,765**	**12,518**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Mayes	2007	2010	2020	2030	2040	2050	2060
Population, Total	39,627	40,790	44,859	48,734	52,804	56,970	61,233
Public-Supplied Population	39,627	40,790	44,859	48,734	52,804	56,970	61,233
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	11,189	11,545	12,189	13,242	14,348	15,480	16,638
11 Agriculture, forestry, fishing and hunting	29	29	30	32	35	38	41
21 Mining, quarrying, and oil and gas extraction	54	55	58	63	69	74	80
22 Utilities	352	360	375	407	441	476	512
23 Construction	659	700	770	836	906	977	1,051
31-33 Manufacturing	2,793	2,738	2,680	2,912	3,155	3,404	3,659
42 Wholesale trade	257	264	277	300	325	351	377
44-45 Retail trade	1,487	1,518	1,579	1,716	1,859	2,006	2,156
48-49 Transportation and warehousing	233	241	255	278	301	324	349
51 Information	96	99	104	113	122	132	142
52 Finance and insurance	280	288	303	329	356	384	413
53 Real estate and rental and leasing	55	58	63	68	74	80	86
54 Professional and technical services	628	687	783	850	921	994	1,068
55 Management of companies and enterprises	21	21	21	23	25	27	29
56 Administrative and waste services	543	585	654	711	770	831	893
61 Educational services	997	1,044	1,125	1,223	1,325	1,429	1,536
62 Health care and social assistance	862	918	1,011	1,098	1,190	1,283	1,379
71 Arts, entertainment, and recreation	107	118	137	149	161	174	187
72 Accommodation and food services	972	1,027	1,121	1,217	1,319	1,423	1,530
81 Other services, except public administration	208	215	229	248	269	290	312
92 Public Administration	551	572	609	662	717	773	831
99 Unclassified	6	6	6	7	7	8	8
Public-Supply Nonresidential Including System Losses (AFY)	1,590	1,636	1,720	1,868	2,024	2,184	2,347
Public-Supply Residential Including System Losses (AFY)	3,788	3,899	4,288	4,658	5,047	5,445	5,853
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	791	813	886	960	1,033	1,090	1,180
Crop Irrigation (AFY)	1,163	1,196	1,303	1,411	1,519	1,602	1,735
Livestock (AFY)	1,488	1,491	1,500	1,510	1,519	1,529	1,538
Oil and Gas Drilling (AFY)	18	25	34	45	57	71	86
Thermoelectric, Withdrawals (AFY)	4,346	4,491	5,010	5,589	6,236	6,956	7,761
Thermoelectric, Consumptive Use (AFY)	2,692	2,782	3,103	3,462	3,862	4,309	4,807
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**12,392**	**12,736**	**13,855**	**15,082**	**16,402**	**17,787**	**19,319**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

McClain	2007	2010	2020	2030	2040	2050	2060
Population, Total	31,849	33,434	39,024	44,206	49,389	54,775	60,263
Public-Supplied Population	24,419	25,634	29,920	33,894	37,867	41,997	46,204
Self-Supplied Population	7,430	7,800	9,104	10,313	11,522	12,778	14,059
Employment, Total	7,228	7,554	8,157	9,240	10,323	11,449	12,596
11 Agriculture, forestry, fishing and hunting	77	78	81	92	102	114	125
21 Mining, quarrying, and oil and gas extraction	365	376	398	451	504	559	615
22 Utilities	25	26	27	30	34	38	41
23 Construction	993	1,056	1,166	1,321	1,476	1,637	1,801
31-33 Manufacturing	260	255	251	284	317	352	387
42 Wholesale trade	127	130	137	155	173	192	211
44-45 Retail trade	1,350	1,378	1,441	1,632	1,824	2,023	2,225
48-49 Transportation and warehousing	171	177	188	213	238	264	290
51 Information	114	117	124	140	156	174	191
52 Finance and insurance	311	320	338	383	428	474	522
53 Real estate and rental and leasing	37	39	43	48	54	60	66
54 Professional and technical services	220	241	276	312	349	387	426
55 Management of companies and enterprises	8	8	8	9	10	11	12
56 Administrative and waste services	207	223	251	284	317	352	387
61 Educational services	431	452	489	554	619	687	756
62 Health care and social assistance	1,226	1,306	1,445	1,637	1,829	2,029	2,232
71 Arts, entertainment, and recreation	55	61	71	81	90	100	110
72 Accommodation and food services	721	762	835	946	1,057	1,173	1,290
81 Other services, except public administration	126	130	139	158	176	195	215
92 Public Administration	403	418	448	507	567	629	692
99 Unclassified	1	1	1	1	1	1	2
Public-Supply Nonresidential Including System Losses (AFY)	1,072	1,119	1,208	1,368	1,528	1,695	1,865
Public-Supply Residential Including System Losses (AFY)	2,925	3,071	3,584	4,060	4,536	5,031	5,535
Self-Supply Residential (AFY)	757	794	927	1,050	1,173	1,301	1,432
Projection of Irrigated Lands (in Acres)	1,674	1,683	1,713	1,742	1,772	1,794	1,831
Crop Irrigation (AFY)	2,853	2,868	2,918	2,969	3,019	3,058	3,120
Livestock (AFY)	910	912	919	926	933	940	947
Oil and Gas Drilling (AFY)	129	183	270	376	501	644	806
Thermoelectric, Withdrawals (AFY)	6,329	6,540	7,296	8,139	9,080	10,130	11,301
Thermoelectric, Consumptive Use (AFY)	3,920	4,051	4,519	5,041	5,624	6,274	7,000
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**14,974**	**15,487**	**17,122**	**18,889**	**20,771**	**22,799**	**25,006**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

McCurtain	2007	2010	2020	2030	2040	2050	2060
Population, Total	33,539	33,939	35,465	36,704	37,753	38,897	39,946
Public-Supplied Population	26,049	26,360	27,545	28,507	29,322	30,210	31,025
Self-Supplied Population	7,490	7,579	7,920	8,197	8,431	8,687	8,921
Employment, Total	10,216	10,618	11,268	11,662	11,995	12,359	12,692
11 Agriculture, forestry, fishing and hunting	262	266	273	282	291	299	307
21 Mining, quarrying, and oil and gas extraction	32	33	34	36	37	38	39
22 Utilities	110	112	117	121	124	128	131
23 Construction	1,129	1,200	1,313	1,359	1,398	1,440	1,479
31-33 Manufacturing	1,485	1,456	1,418	1,468	1,510	1,556	1,598
42 Wholesale trade	179	184	192	198	204	210	216
44-45 Retail trade	1,069	1,091	1,130	1,169	1,203	1,239	1,273
48-49 Transportation and warehousing	481	497	524	542	558	575	590
51 Information	142	146	153	158	163	167	172
52 Finance and insurance	236	243	254	263	270	278	286
53 Real estate and rental and leasing	76	80	87	90	92	95	98
54 Professional and technical services	417	456	517	535	551	567	583
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	339	365	406	420	432	445	457
61 Educational services	1,545	1,618	1,735	1,796	1,847	1,903	1,954
62 Health care and social assistance	1,239	1,320	1,446	1,497	1,540	1,586	1,629
71 Arts, entertainment, and recreation	136	151	173	179	185	190	195
72 Accommodation and food services	508	537	583	603	621	639	657
81 Other services, except public administration	209	216	229	237	243	251	258
92 Public Administration	622	646	685	709	729	751	771
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	1,385	1,437	1,523	1,576	1,621	1,670	1,715
Public-Supply Residential Including System Losses (AFY)	2,841	2,875	3,004	3,109	3,198	3,295	3,384
Self-Supply Residential (AFY)	694	703	734	760	782	805	827
Projection of Irrigated Lands (in Acres)	421	500	762	1,025	1,287	1,489	1,812
Crop Irrigation (AFY)	721	856	1,306	1,756	2,205	2,550	3,105
Livestock (AFY)	2,035	2,055	2,123	2,191	2,259	2,327	2,395
Oil and Gas Drilling (AFY)	0	0	1	1	1	1	1
Thermoelectric, Withdrawals (AFY)	956	988	1,103	1,230	1,372	1,531	1,708
Thermoelectric, Consumptive Use (AFY)	592	612	683	762	850	948	1,058
Self-Supply Large Industry (AFY)	34,739	34,058	33,179	34,339	35,320	36,390	37,371
Total Water Demand, All Sectors (AFY)*	**43,372**	**42,973**	**42,973**	**44,961**	**46,758**	**48,570**	**50,506**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

McIntosh	2007	2010	2020	2030	2040	2050	2060
Population, Total	19,709	20,385	22,828	25,364	28,183	31,377	34,758
Public-Supplied Population	19,709	20,385	22,828	25,364	28,183	31,377	34,758
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	4,258	4,442	4,768	5,298	5,886	6,553	7,260
11 Agriculture, forestry, fishing and hunting	13	13	14	15	17	19	21
21 Mining, quarrying, and oil and gas extraction	30	31	33	36	40	45	50
22 Utilities	66	68	71	79	87	97	108
23 Construction	111	118	130	145	161	179	198
31-33 Manufacturing	274	269	263	293	325	362	401
42 Wholesale trade	48	49	52	58	64	71	79
44-45 Retail trade	883	901	939	1,044	1,160	1,291	1,430
48-49 Transportation and warehousing	184	190	202	224	249	277	307
51 Information	26	27	28	31	35	39	43
52 Finance and insurance	139	143	150	167	186	207	229
53 Real estate and rental and leasing	21	22	24	27	30	33	37
54 Professional and technical services	131	143	164	182	202	225	249
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	34	37	41	46	51	56	62
61 Educational services	477	500	539	599	666	741	821
62 Health care and social assistance	806	858	947	1,052	1,169	1,301	1,442
71 Arts, entertainment, and recreation	154	171	198	220	244	272	301
72 Accommodation and food services	445	470	514	571	634	706	782
81 Other services, except public administration	76	79	84	93	103	115	127
92 Public Administration	339	352	376	418	464	517	572
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	624	656	711	790	878	978	1,083
Public-Supply Residential Including System Losses (AFY)	1,768	1,829	2,048	2,276	2,529	2,815	3,119
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	572	572	574	575	576	577	579
Crop Irrigation (AFY)	682	682	684	685	687	688	690
Livestock (AFY)	669	674	694	713	733	753	772
Oil and Gas Drilling (AFY)	400	609	1,242	2,079	3,120	4,363	5,810
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**4,143**	**4,450**	**5,380**	**6,544**	**7,946**	**9,597**	**11,474**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Murray	2007	2010	2020	2030	2040	2050	2060
Population, Total	12,695	13,035	14,169	15,491	16,719	18,136	19,553
Public-Supplied Population	12,695	13,035	14,169	15,491	16,719	18,136	19,553
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	5,089	5,337	5,754	6,291	6,789	7,365	7,940
11 Agriculture, forestry, fishing and hunting	102	103	107	117	126	136	147
21 Mining, quarrying, and oil and gas extraction	213	219	231	253	273	296	319
22 Utilities	72	74	77	84	90	98	106
23 Construction	185	196	216	236	254	276	298
31-33 Manufacturing	146	143	140	153	165	179	193
42 Wholesale trade	145	149	156	170	184	199	215
44-45 Retail trade	572	584	607	663	716	776	837
48-49 Transportation and warehousing	155	161	170	186	200	217	234
51 Information	62	64	67	74	79	86	93
52 Finance and insurance	119	122	128	140	152	164	177
53 Real estate and rental and leasing	25	26	29	31	34	37	39
54 Professional and technical services	164	180	205	224	242	262	283
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	57	62	69	75	81	88	95
61 Educational services	284	298	320	350	378	410	442
62 Health care and social assistance	1,931	2,056	2,262	2,473	2,669	2,896	3,122
71 Arts, entertainment, and recreation	80	89	102	112	121	131	141
72 Accommodation and food services	264	279	304	333	359	389	420
81 Other services, except public administration	71	74	78	85	92	100	108
92 Public Administration	437	454	483	528	570	618	666
99 Unclassified	4	4	4	4	4	5	5
Public-Supply Nonresidential Including System Losses (AFY)	742	779	840	918	991	1,075	1,159
Public-Supply Residential Including System Losses (AFY)	1,883	1,933	2,102	2,298	2,480	2,690	2,900
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	0	36	156	276	397	489	637
Crop Irrigation (AFY)	0	43	188	332	476	587	765
Livestock (AFY)	392	401	431	461	491	521	552
Oil and Gas Drilling (AFY)	26	36	49	65	82	102	123
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**3,043**	**3,192**	**3,609**	**4,074**	**4,521**	**4,975**	**5,499**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Muskogee	2007	2010	2020	2030	2040	2050	2060
Population, Total	71,116	71,662	74,088	76,311	78,232	80,152	82,072
Public-Supplied Population	64,266	64,759	66,951	68,961	70,696	72,432	74,167
Self-Supplied Population	6,850	6,903	7,136	7,350	7,535	7,720	7,905
Employment, Total	28,350	29,508	31,349	32,289	33,102	33,915	34,727
11 Agriculture, forestry, fishing and hunting	151	153	157	162	166	170	174
21 Mining, quarrying, and oil and gas extraction	51	53	55	57	58	60	61
22 Utilities	433	443	459	473	484	496	508
23 Construction	1,451	1,542	1,686	1,736	1,780	1,824	1,867
31-33 Manufacturing	3,675	3,603	3,506	3,612	3,703	3,793	3,884
42 Wholesale trade	570	585	610	628	644	660	675
44-45 Retail trade	3,675	3,752	3,880	3,997	4,097	4,198	4,298
48-49 Transportation and warehousing	934	965	1,016	1,046	1,072	1,099	1,125
51 Information	370	380	397	409	419	429	440
52 Finance and insurance	681	700	732	754	773	792	811
53 Real estate and rental and leasing	203	214	231	238	244	250	256
54 Professional and technical services	558	611	692	712	730	748	766
55 Management of companies and enterprises	17	17	17	17	18	18	19
56 Administrative and waste services	2,082	2,243	2,492	2,567	2,632	2,696	2,761
61 Educational services	3,419	3,581	3,836	3,951	4,050	4,150	4,249
62 Health care and social assistance	4,674	4,977	5,449	5,613	5,754	5,895	6,037
71 Arts, entertainment, and recreation	522	578	665	685	703	720	737
72 Accommodation and food services	2,168	2,292	2,485	2,560	2,624	2,688	2,753
81 Other services, except public administration	477	494	521	537	550	564	577
92 Public Administration	2,235	2,321	2,457	2,531	2,595	2,659	2,722
99 Unclassified	5	5	5	5	5	5	6
Public-Supply Nonresidential Including System Losses (AFY)	3,454	3,598	3,826	3,941	4,040	4,139	4,239
Public-Supply Residential Including System Losses (AFY)	6,483	6,533	6,754	6,957	7,132	7,307	7,482
Self-Supply Residential (AFY)	658	663	686	706	724	742	759
Projection of Irrigated Lands (in Acres)	8,154	8,154	8,154	8,154	8,154	8,154	8,154
Crop Irrigation (AFY)	8,882	8,882	8,882	8,882	8,882	8,882	8,882
Livestock (AFY)	1,137	1,139	1,146	1,152	1,159	1,166	1,172
Oil and Gas Drilling (AFY)	55	82	151	242	354	487	640
Thermoelectric, Withdrawals (AFY)	100,057	103,395	115,348	128,683	143,560	160,157	178,672
Thermoelectric, Consumptive Use (AFY)	61,970	64,038	71,441	79,701	88,915	99,194	110,661
Self-Supply Large Industry (AFY)	22,068	21,658	21,112	21,746	22,293	22,841	23,388
Total Water Demand, All Sectors (AFY)*	**142,794**	**145,950**	**157,906**	**172,310**	**188,144**	**205,719**	**225,234**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Noble	2007	2010	2020	2030	2040	2050	2060
Population, Total	11,124	11,293	11,858	12,235	12,611	12,893	13,176
Public-Supplied Population	9,604	9,750	10,238	10,563	10,888	11,132	11,375
Self-Supplied Population	1,520	1,543	1,620	1,672	1,723	1,762	1,800
Employment, Total	4,290	4,469	4,760	4,911	5,063	5,176	5,289
11 Agriculture, forestry, fishing and hunting	12	12	12	12	13	13	13
21 Mining, quarrying, and oil and gas extraction	175	181	189	195	201	206	211
22 Utilities	181	185	192	198	205	209	214
23 Construction	300	319	349	360	371	379	388
31-33 Manufacturing	503	493	480	496	511	522	534
42 Wholesale trade	106	109	114	117	121	123	126
44-45 Retail trade	295	301	312	322	332	339	347
48-49 Transportation and warehousing	174	180	190	196	202	206	211
51 Information	25	26	27	28	29	30	30
52 Finance and insurance	141	145	152	157	161	165	169
53 Real estate and rental and leasing	19	20	22	22	23	24	24
54 Professional and technical services	217	238	270	278	287	293	300
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	100	108	120	124	127	130	133
61 Educational services	530	555	596	615	634	648	662
62 Health care and social assistance	445	474	520	536	553	565	578
71 Arts, entertainment, and recreation	140	155	179	184	190	194	198
72 Accommodation and food services	383	405	440	454	468	478	489
81 Other services, except public administration	54	56	59	61	63	64	66
92 Public Administration	488	506	537	554	571	584	597
99 Unclassified	1	1	1	1	1	1	1
Public-Supply Nonresidential Including System Losses (AFY)	704	735	785	810	835	854	872
Public-Supply Residential Including System Losses (AFY)	914	928	974	1,005	1,036	1,059	1,082
Self-Supply Residential (AFY)	126	128	134	138	143	146	149
Projection of Irrigated Lands (in Acres)	833	833	833	833	833	833	833
Crop Irrigation (AFY)	1,223	1,223	1,223	1,223	1,223	1,223	1,223
Livestock (AFY)	874	874	876	879	881	883	885
Oil and Gas Drilling (AFY)	271	384	551	752	986	1,252	1,552
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**4,111**	**4,270**	**4,544**	**4,807**	**5,102**	**5,416**	**5,763**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Nowata	2007	2010	2020	2030	2040	2050	2060
Population, Total	10,723	11,170	12,752	14,335	15,917	17,592	19,361
Public-Supplied Population	10,033	10,451	11,932	13,412	14,893	16,460	18,115
Self-Supplied Population	690	719	821	922	1,024	1,132	1,246
Employment, Total	1,788	1,852	1,974	2,219	2,464	2,723	2,997
11 Agriculture, forestry, fishing and hunting	14	14	15	17	18	20	22
21 Mining, quarrying, and oil and gas extraction	12	12	13	15	16	18	20
22 Utilities	42	43	45	51	57	63	69
23 Construction	130	138	152	171	190	210	231
31-33 Manufacturing	288	282	278	312	346	383	421
42 Wholesale trade	110	113	119	134	148	164	180
44-45 Retail trade	154	157	164	185	205	227	249
48-49 Transportation and warehousing	66	68	72	81	90	100	110
51 Information	11	11	11	13	14	16	17
52 Finance and insurance	71	73	77	87	96	106	117
53 Real estate and rental and leasing	21	22	24	27	30	33	37
54 Professional and technical services	26	28	33	37	41	45	49
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	25	27	30	34	38	42	46
61 Educational services	298	312	338	380	421	466	513
62 Health care and social assistance	273	291	321	361	401	443	488
71 Arts, entertainment, and recreation	15	16	19	21	24	26	29
72 Accommodation and food services	81	85	94	105	117	129	142
81 Other services, except public administration	25	26	28	31	35	38	42
92 Public Administration	127	132	141	159	176	195	214
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	242	250	266	299	333	368	405
Public-Supply Residential Including System Losses (AFY)	832	867	990	1,113	1,236	1,366	1,503
Self-Supply Residential (AFY)	49	51	58	65	72	80	88
Projection of Irrigated Lands (in Acres)	131	165	276	388	500	585	723
Crop Irrigation (AFY)	208	261	438	616	793	929	1,148
Livestock (AFY)	1,109	1,109	1,108	1,107	1,106	1,105	1,104
Oil and Gas Drilling (AFY)	283	397	543	712	904	1,118	1,356
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**2,723**	**2,935**	**3,403**	**3,912**	**4,443**	**4,966**	**5,603**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Okfuskee	2007	2010	2020	2030	2040	2050	2060
Population, Total	11,248	11,305	11,590	11,875	12,160	12,445	12,825
Public-Supplied Population	10,148	10,199	10,457	10,714	10,971	11,228	11,571
Self-Supplied Population	1,100	1,106	1,133	1,161	1,189	1,217	1,254
Employment, Total	2,282	2,384	2,545	2,608	2,670	2,733	2,816
11 Agriculture, forestry, fishing and hunting	46	47	48	49	50	51	53
21 Mining, quarrying, and oil and gas extraction	70	72	76	77	79	81	84
22 Utilities	30	31	32	33	33	34	35
23 Construction	69	73	80	82	84	86	88
31-33 Manufacturing	90	88	86	88	90	92	95
42 Wholesale trade	45	46	48	49	51	52	53
44-45 Retail trade	222	227	234	240	246	252	259
48-49 Transportation and warehousing	36	37	39	40	41	42	43
51 Information	11	12	12	12	13	13	13
52 Finance and insurance	80	82	86	88	90	92	95
53 Real estate and rental and leasing	12	13	14	14	14	15	15
54 Professional and technical services	40	44	50	51	53	54	56
55 Management of companies and enterprises	12	12	12	12	12	13	13
56 Administrative and waste services	24	26	29	29	30	31	32
61 Educational services	420	440	471	483	494	506	521
62 Health care and social assistance	485	516	565	579	593	607	625
71 Arts, entertainment, and recreation	63	70	81	83	85	87	89
72 Accommodation and food services	87	92	99	102	104	107	110
81 Other services, except public administration	21	22	23	23	24	25	25
92 Public Administration	419	435	461	472	483	495	510
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	357	374	401	411	421	431	444
Public-Supply Residential Including System Losses (AFY)	1,028	1,034	1,060	1,086	1,112	1,138	1,173
Self-Supply Residential (AFY)	95	95	98	100	102	105	108
Projection of Irrigated Lands (in Acres)	1,282	1,322	1,455	1,588	1,721	1,823	1,987
Crop Irrigation (AFY)	1,830	1,887	2,077	2,267	2,457	2,602	2,836
Livestock (AFY)	726	728	736	744	752	760	768
Oil and Gas Drilling (AFY)	174	252	411	612	854	1,138	1,464
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**4,210**	**4,370**	**4,782**	**5,219**	**5,698**	**6,174**	**6,792**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Oklahoma	2007	2010	2020	2030	2040	2050	2060
Population, Total	701,807	713,774	748,374	779,107	802,309	819,202	835,892
Public-Supplied Population	687,767	699,495	733,403	763,521	786,259	802,814	819,169
Self-Supplied Population	14,040	14,279	14,972	15,586	16,051	16,389	16,722
Employment, Total	420,127	438,854	469,036	488,298	502,840	513,427	523,887
11 Agriculture, forestry, fishing and hunting	199	202	207	216	222	227	231
21 Mining, quarrying, and oil and gas extraction	10,310	10,624	11,145	11,603	11,949	12,200	12,449
22 Utilities	3,270	3,344	3,469	3,612	3,719	3,797	3,875
23 Construction	18,598	19,774	21,635	22,523	23,194	23,682	24,165
31-33 Manufacturing	28,349	27,793	27,081	28,193	29,032	29,644	30,248
42 Wholesale trade	19,460	19,975	20,841	21,697	22,343	22,814	23,278
44-45 Retail trade	46,613	47,589	49,273	51,297	52,824	53,936	55,035
48-49 Transportation and warehousing	13,932	14,402	15,176	15,799	16,269	16,612	16,950
51 Information	12,177	12,515	13,079	13,616	14,022	14,317	14,609
52 Finance and insurance	18,074	18,588	19,444	20,243	20,846	21,285	21,718
53 Real estate and rental and leasing	9,495	10,009	10,829	11,273	11,609	11,854	12,095
54 Professional and technical services	21,916	23,979	27,196	28,313	29,156	29,770	30,376
55 Management of companies and enterprises	4,551	4,527	4,512	4,697	4,837	4,939	5,040
56 Administrative and waste services	36,205	39,006	43,401	45,183	46,529	47,508	48,476
61 Educational services	27,496	28,797	30,884	32,153	33,110	33,807	34,496
62 Health care and social assistance	54,290	57,810	63,373	65,976	67,940	69,371	70,784
71 Arts, entertainment, and recreation	6,374	7,064	8,134	8,468	8,721	8,904	9,086
72 Accommodation and food services	35,785	37,825	41,068	42,754	44,027	44,954	45,870
81 Other services, except public administration	11,258	11,660	12,317	12,823	13,205	13,483	13,757
92 Public Administration	41,635	43,232	45,832	47,714	49,135	50,170	51,192
99 Unclassified	139	139	140	145	150	153	156
Public-Supply Nonresidential Including System Losses (AFY)	59,203	61,862	66,147	68,863	70,914	72,407	73,882
Public-Supply Residential Including System Losses (AFY)	61,028	62,069	65,078	67,750	69,768	71,237	72,688
Self-Supply Residential (AFY)	1,079	1,098	1,151	1,198	1,234	1,260	1,286
Projection of Irrigated Lands (in Acres)	2,935	2,935	2,935	2,935	2,935	2,935	2,935
Crop Irrigation (AFY)	5,537	5,537	5,537	5,537	5,537	5,537	5,537
Livestock (AFY)	370	371	374	377	380	383	386
Oil and Gas Drilling (AFY)	196	280	430	615	834	1,089	1,379
Thermoelectric, Withdrawals (AFY)	9,727	10,051	11,213	12,510	13,956	15,569	17,369
Thermoelectric, Consumptive Use (AFY)	6,024	6,225	6,945	7,748	8,644	9,643	10,758
Self-Supply Large Industry (AFY)	249	244	238	247	255	260	265
Total Water Demand, All Sectors (AFY)*	**137,389**	**141,512**	**150,167**	**157,097**	**162,877**	**167,742**	**172,792**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Okmulgee	2007	2010	2020	2030	2040	2050	2060
Population, Total	39,300	40,100	43,053	45,625	48,292	51,054	53,816
Public-Supplied Population	39,300	40,100	43,053	45,625	48,292	51,054	53,816
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	9,995	10,371	11,012	11,670	12,352	13,059	13,765
11 Agriculture, forestry, fishing and hunting	20	20	21	22	23	25	26
21 Mining, quarrying, and oil and gas extraction	181	187	196	208	220	233	245
22 Utilities	83	85	89	94	99	105	111
23 Construction	204	217	238	252	267	282	297
31-33 Manufacturing	1,435	1,407	1,374	1,457	1,542	1,630	1,718
42 Wholesale trade	151	155	162	172	182	192	203
44-45 Retail trade	1,283	1,310	1,360	1,441	1,525	1,612	1,700
48-49 Transportation and warehousing	241	249	263	279	295	312	329
51 Information	76	78	82	87	92	97	103
52 Finance and insurance	324	333	349	370	392	414	437
53 Real estate and rental and leasing	64	68	74	78	83	87	92
54 Professional and technical services	162	177	202	214	226	239	252
55 Management of companies and enterprises	94	94	93	99	105	111	117
56 Administrative and waste services	166	179	200	212	224	237	250
61 Educational services	1,120	1,173	1,261	1,337	1,415	1,496	1,577
62 Health care and social assistance	2,175	2,316	2,545	2,697	2,855	3,018	3,181
71 Arts, entertainment, and recreation	106	118	136	144	152	161	170
72 Accommodation and food services	860	909	990	1,049	1,110	1,173	1,237
81 Other services, except public administration	218	226	239	254	268	284	299
92 Public Administration	1,031	1,071	1,138	1,206	1,276	1,350	1,423
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	1,510	1,566	1,663	1,762	1,865	1,972	2,079
Public-Supply Residential Including System Losses (AFY)	9,176	9,363	10,053	10,653	11,276	11,921	12,566
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	860	860	860	860	860	860	860
Crop Irrigation (AFY)	1,250	1,250	1,250	1,250	1,250	1,250	1,250
Livestock (AFY)	743	744	747	750	753	756	759
Oil and Gas Drilling (AFY)	137	194	285	395	525	674	843
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**12,816**	**13,118**	**13,998**	**14,811**	**15,670**	**16,573**	**17,496**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Osage	2007	2010	2020	2030	2040	2050	2060
Population, Total	45,523	46,462	49,788	52,233	54,483	56,733	59,276
Public-Supplied Population	38,763	39,563	42,394	44,477	46,392	48,308	50,474
Self-Supplied Population	6,760	6,899	7,393	7,756	8,091	8,425	8,802
Employment, Total	5,924	6,185	6,619	6,944	7,243	7,542	7,880
11 Agriculture, forestry, fishing and hunting	64	65	67	70	73	76	79
21 Mining, quarrying, and oil and gas extraction	477	492	517	542	565	589	615
22 Utilities	42	43	45	47	49	51	53
23 Construction	291	310	340	356	372	387	404
31-33 Manufacturing	236	231	226	237	247	257	269
42 Wholesale trade	79	81	85	89	93	97	101
44-45 Retail trade	690	704	731	767	800	833	870
48-49 Transportation and warehousing	80	83	87	92	96	99	104
51 Information	37	38	40	42	44	45	47
52 Finance and insurance	203	209	219	230	239	249	260
53 Real estate and rental and leasing	31	33	36	37	39	41	42
54 Professional and technical services	163	179	203	213	222	231	242
55 Management of companies and enterprises	8	8	8	9	9	9	10
56 Administrative and waste services	237	256	285	299	312	325	339
61 Educational services	764	800	860	902	941	980	1,024
62 Health care and social assistance	649	691	759	796	831	865	904
71 Arts, entertainment, and recreation	181	201	232	243	254	264	276
72 Accommodation and food services	394	416	453	475	496	516	539
81 Other services, except public administration	135	140	148	155	162	169	176
92 Public Administration	1,161	1,206	1,280	1,343	1,401	1,459	1,524
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	1,114	1,164	1,248	1,309	1,365	1,422	1,486
Public-Supply Residential Including System Losses (AFY)	6,595	6,731	7,213	7,567	7,893	8,219	8,587
Self-Supply Residential (AFY)	978	998	1,069	1,122	1,170	1,218	1,273
Projection of Irrigated Lands (in Acres)	435	476	611	746	881	984	1,151
Crop Irrigation (AFY)	492	538	691	843	996	1,113	1,302
Livestock (AFY)	2,317	2,323	2,343	2,363	2,384	2,404	2,424
Oil and Gas Drilling (AFY)	369	517	708	928	1,178	1,458	1,767
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	587	576	562	590	615	640	669
Total Water Demand, All Sectors (AFY)*	**12,451**	**12,846**	**13,833**	**14,722**	**15,601**	**16,474**	**17,507**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Ottawa	2007	2010	2020	2030	2040	2050	2060
Population, Total	32,474	32,984	35,253	37,426	39,789	42,246	44,704
Public-Supplied Population	25,484	25,885	27,665	29,370	31,225	33,153	35,081
Self-Supplied Population	6,990	7,100	7,588	8,056	8,565	9,094	9,622
Employment, Total	11,346	11,825	12,624	13,403	14,249	15,129	16,009
11 Agriculture, forestry, fishing and hunting	486	493	507	538	572	608	643
21 Mining, quarrying, and oil and gas extraction	35	36	38	40	43	45	48
22 Utilities	104	106	110	117	124	132	140
23 Construction	229	244	267	284	302	320	339
31-33 Manufacturing	1,768	1,733	1,692	1,797	1,910	2,028	2,146
42 Wholesale trade	301	309	323	343	365	387	410
44-45 Retail trade	1,148	1,172	1,216	1,291	1,372	1,457	1,542
48-49 Transportation and warehousing	204	211	223	237	252	267	283
51 Information	84	86	90	96	102	108	115
52 Finance and insurance	310	319	335	355	378	401	424
53 Real estate and rental and leasing	85	90	97	103	110	117	123
54 Professional and technical services	353	386	439	466	495	526	557
55 Management of companies and enterprises	93	93	92	98	104	111	117
56 Administrative and waste services	407	439	489	520	552	587	621
61 Educational services	904	946	1,017	1,080	1,148	1,219	1,290
62 Health care and social assistance	1,894	2,017	2,215	2,352	2,500	2,655	2,809
71 Arts, entertainment, and recreation	1,156	1,281	1,478	1,569	1,668	1,771	1,874
72 Accommodation and food services	671	709	772	819	871	925	978
81 Other services, except public administration	203	210	223	236	251	267	282
92 Public Administration	869	902	959	1,018	1,082	1,149	1,215
99 Unclassified	41	41	41	44	47	49	52
Public-Supply Nonresidential Including System Losses (AFY)	2,068	2,184	2,373	2,519	2,678	2,844	3,009
Public-Supply Residential Including System Losses (AFY)	2,949	2,996	3,202	3,399	3,614	3,837	4,060
Self-Supply Residential (AFY)	688	698	746	792	842	895	947
Projection of Irrigated Lands (in Acres)	287	300	342	384	426	458	510
Crop Irrigation (AFY)	447	467	533	598	664	714	795
Livestock (AFY)	1,051	1,055	1,071	1,086	1,102	1,118	1,133
Oil and Gas Drilling (AFY)	0	0	0	0	0	0	0
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**7,203**	**7,400**	**7,925**	**8,396**	**8,900**	**9,407**	**9,944**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Pawnee	2007	2010	2020	2030	2040	2050	2060
Population, Total	16,447	16,950	18,813	20,489	22,258	24,121	25,984
Public-Supplied Population	11,797	12,158	13,494	14,696	15,965	17,301	18,637
Self-Supplied Population	4,650	4,792	5,319	5,793	6,293	6,820	7,346
Employment, Total	3,377	3,528	3,791	4,129	4,486	4,861	5,237
11 Agriculture, forestry, fishing and hunting	4	5	5	5	6	6	6
21 Mining, quarrying, and oil and gas extraction	177	182	192	209	227	246	265
22 Utilities	120	123	128	139	151	164	177
23 Construction	115	122	134	146	159	172	185
31-33 Manufacturing	136	133	131	142	155	167	180
42 Wholesale trade	74	76	80	87	94	102	110
44-45 Retail trade	391	399	416	453	492	533	574
48-49 Transportation and warehousing	60	62	66	72	78	85	91
51 Information	22	23	24	26	28	30	33
52 Finance and insurance	131	135	142	154	168	182	196
53 Real estate and rental and leasing	24	25	27	29	32	35	37
54 Professional and technical services	137	150	172	187	203	220	237
55 Management of companies and enterprises	20	20	20	22	24	26	28
56 Administrative and waste services	92	99	111	121	131	142	153
61 Educational services	408	427	461	502	545	591	636
62 Health care and social assistance	749	798	879	957	1,040	1,127	1,214
71 Arts, entertainment, and recreation	9	10	12	13	14	15	16
72 Accommodation and food services	237	251	273	298	324	351	378
81 Other services, except public administration	35	36	39	42	46	49	53
92 Public Administration	435	452	481	524	569	617	665
99 Unclassified	1	1	1	1	1	1	1
Public-Supply Nonresidential Including System Losses (AFY)	510	532	570	621	674	731	787
Public-Supply Residential Including System Losses (AFY)	1,764	1,818	2,018	2,198	2,388	2,587	2,787
Self-Supply Residential (AFY)	591	609	676	736	800	867	934
Projection of Irrigated Lands (in Acres)	37	44	67	90	114	131	160
Crop Irrigation (AFY)	73	87	133	179	225	260	317
Livestock (AFY)	616	616	617	618	620	621	622
Oil and Gas Drilling (AFY)	48	70	116	174	244	326	420
Thermoelectric, Withdrawals (AFY)	36,650	37,872	42,251	47,135	52,584	58,663	65,445
Thermoelectric, Consumptive Use (AFY)	22,699	23,456	26,168	29,193	32,568	36,334	40,534
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**40,252**	**41,604**	**46,380**	**51,661**	**57,534**	**64,055**	**71,313**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Payne	2007	2010	2020	2030	2040	2050	2060
Population, Total	79,931	82,684	88,978	95,593	102,101	106,688	111,063
Public-Supplied Population	72,011	74,491	80,162	86,121	91,984	96,117	100,058
Self-Supplied Population	7,920	8,193	8,816	9,472	10,117	10,571	11,005
Employment, Total	34,260	35,721	38,151	40,987	43,777	45,744	47,620
11 Agriculture, forestry, fishing and hunting	57	58	59	64	68	71	74
21 Mining, quarrying, and oil and gas extraction	837	863	906	974	1,040	1,087	1,131
22 Utilities	3,453	3,530	3,669	3,942	4,210	4,400	4,580
23 Construction	2,186	2,325	2,548	2,737	2,924	3,055	3,180
31-33 Manufacturing	2,657	2,605	2,543	2,732	2,918	3,049	3,174
42 Wholesale trade	422	433	453	486	520	543	565
44-45 Retail trade	3,823	3,903	4,048	4,349	4,645	4,854	5,053
48-49 Transportation and warehousing	804	831	877	943	1,007	1,052	1,095
51 Information	605	622	651	699	747	780	812
52 Finance and insurance	778	800	838	901	962	1,005	1,047
53 Real estate and rental and leasing	579	610	662	711	759	793	826
54 Professional and technical services	864	945	1,074	1,154	1,232	1,288	1,341
55 Management of companies and enterprises	48	48	48	51	55	57	60
56 Administrative and waste services	1,888	2,035	2,268	2,436	2,602	2,719	2,831
61 Educational services	5,629	5,896	6,334	6,805	7,268	7,595	7,906
62 Health care and social assistance	2,929	3,119	3,425	3,680	3,930	4,107	4,275
71 Arts, entertainment, and recreation	1,282	1,421	1,639	1,761	1,881	1,965	2,046
72 Accommodation and food services	2,984	3,154	3,431	3,686	3,937	4,113	4,282
81 Other services, except public administration	992	1,027	1,087	1,168	1,248	1,304	1,357
92 Public Administration	1,434	1,489	1,581	1,699	1,815	1,896	1,974
99 Unclassified	8	8	8	9	9	10	10
Public-Supply Nonresidential Including System Losses (AFY)	5,259	5,515	5,936	6,377	6,811	7,118	7,409
Public-Supply Residential Including System Losses (AFY)	6,935	7,174	7,720	8,294	8,858	9,256	9,636
Self-Supply Residential (AFY)	648	671	722	775	828	865	901
Projection of Irrigated Lands (in Acres)	898	899	903	906	910	913	917
Crop Irrigation (AFY)	1,332	1,333	1,339	1,344	1,349	1,353	1,360
Livestock (AFY)	828	831	839	848	856	865	874
Oil and Gas Drilling (AFY)	165	238	380	557	770	1,019	1,304
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**15,167**	**15,761**	**16,935**	**18,195**	**19,474**	**20,477**	**21,484**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Pittsburg	2007	2010	2020	2030	2040	2050	2060
Population, Total	44,711	45,190	47,285	49,080	51,175	53,569	56,163
Public-Supplied Population	44,711	45,190	47,285	49,080	51,175	53,569	56,163
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	16,912	17,570	18,643	19,351	20,177	21,121	22,144
11 Agriculture, forestry, fishing and hunting	26	26	27	28	29	31	32
21 Mining, quarrying, and oil and gas extraction	369	380	399	414	432	452	474
22 Utilities	169	173	179	186	194	203	213
23 Construction	657	699	764	793	827	866	908
31-33 Manufacturing	2,353	2,307	2,248	2,334	2,433	2,547	2,670
42 Wholesale trade	282	289	302	314	327	342	359
44-45 Retail trade	2,092	2,136	2,212	2,296	2,394	2,506	2,627
48-49 Transportation and warehousing	568	587	619	642	670	701	735
51 Information	162	166	174	181	188	197	207
52 Finance and insurance	420	432	452	469	489	512	537
53 Real estate and rental and leasing	174	183	198	206	215	225	236
54 Professional and technical services	340	372	421	437	456	478	501
55 Management of companies and enterprises	10	9	9	10	10	11	11
56 Administrative and waste services	1,238	1,333	1,484	1,540	1,606	1,681	1,762
61 Educational services	873	915	981	1,018	1,062	1,112	1,165
62 Health care and social assistance	3,096	3,297	3,615	3,752	3,912	4,095	4,294
71 Arts, entertainment, and recreation	80	88	102	105	110	115	121
72 Accommodation and food services	1,058	1,118	1,214	1,261	1,314	1,376	1,442
81 Other services, except public administration	311	322	340	353	368	386	404
92 Public Administration	2,635	2,736	2,901	3,011	3,140	3,287	3,446
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	3,088	3,162	3,288	3,412	3,558	3,725	3,905
Public-Supply Residential Including System Losses (AFY)	5,227	5,283	5,528	5,738	5,983	6,262	6,566
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	1,671	1,710	1,842	1,973	2,105	2,206	2,368
Crop Irrigation (AFY)	2,793	2,859	3,079	3,299	3,519	3,687	3,958
Livestock (AFY)	1,176	1,181	1,194	1,208	1,221	1,235	1,248
Oil and Gas Drilling (AFY)	5,838	8,477	16,343	11,617	8,836	5,019	165
Thermoelectric, Withdrawals (AFY)	12,886	13,316	14,855	16,572	18,488	20,626	23,010
Thermoelectric, Consumptive Use (AFY)	7,981	8,247	9,201	10,264	11,451	12,775	14,251
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**31,008**	**34,277**	**44,287**	**41,846**	**41,605**	**40,553**	**38,853**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Pontotoc	2007	2010	2020	2030	2040	2050	2060
Population, Total	36,571	36,999	38,426	39,751	41,076	42,299	43,522
Public-Supplied Population	31,081	31,445	32,658	33,784	34,910	35,949	36,989
Self-Supplied Population	5,490	5,554	5,768	5,967	6,166	6,350	6,534
Employment, Total	18,407	19,243	20,573	21,282	21,992	22,647	23,301
11 Agriculture, forestry, fishing and hunting	39	40	41	42	43	45	46
21 Mining, quarrying, and oil and gas extraction	247	255	267	276	285	294	302
22 Utilities	199	203	211	218	225	232	239
23 Construction	619	658	720	744	769	792	815
31-33 Manufacturing	1,707	1,674	1,629	1,686	1,742	1,794	1,846
42 Wholesale trade	578	593	619	640	661	681	701
44-45 Retail trade	1,796	1,834	1,898	1,963	2,028	2,089	2,149
48-49 Transportation and warehousing	356	368	388	401	415	427	439
51 Information	138	142	148	153	158	163	168
52 Finance and insurance	1,378	1,417	1,481	1,532	1,584	1,631	1,678
53 Real estate and rental and leasing	114	120	130	134	139	143	147
54 Professional and technical services	1,930	2,112	2,393	2,476	2,558	2,634	2,711
55 Management of companies and enterprises	150	150	149	154	159	164	169
56 Administrative and waste services	1,331	1,434	1,594	1,649	1,704	1,755	1,806
61 Educational services	2,155	2,257	2,419	2,502	2,586	2,663	2,740
62 Health care and social assistance	2,518	2,681	2,937	3,038	3,139	3,233	3,326
71 Arts, entertainment, and recreation	185	205	236	244	252	259	267
72 Accommodation and food services	1,150	1,216	1,319	1,364	1,410	1,452	1,494
81 Other services, except public administration	238	246	260	269	278	286	295
92 Public Administration	1,573	1,633	1,730	1,790	1,850	1,905	1,960
99 Unclassified	5	5	5	5	5	6	6
Public-Supply Nonresidential Including System Losses (AFY)	2,326	2,428	2,589	2,678	2,767	2,850	2,932
Public-Supply Residential Including System Losses (AFY)	3,605	3,647	3,787	3,918	4,049	4,169	4,290
Self-Supply Residential (AFY)	565	572	594	615	635	654	673
Projection of Irrigated Lands (in Acres)	788	916	1,341	1,767	2,192	2,519	3,043
Crop Irrigation (AFY)	1,465	1,702	2,493	3,284	4,075	4,682	5,657
Livestock (AFY)	848	853	870	886	903	919	936
Oil and Gas Drilling (AFY)	131	186	275	382	509	654	818
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**8,941**	**9,388**	**10,608**	**11,763**	**12,937**	**13,928**	**15,305**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Pottawatomie	2007	2010	2020	2030	2040	2050	2060
Population, Total	69,038	70,426	75,256	79,783	84,109	88,335	92,762
Public-Supplied Population	48,208	49,177	52,550	55,711	58,732	61,683	64,774
Self-Supplied Population	20,830	21,249	22,706	24,072	25,377	26,652	27,988
Employment, Total	20,480	21,292	22,649	24,011	25,313	26,585	27,917
11 Agriculture, forestry, fishing and hunting	22	22	23	24	26	27	28
21 Mining, quarrying, and oil and gas extraction	180	185	195	207	218	229	240
22 Utilities	201	206	214	226	239	251	263
23 Construction	846	899	986	1,045	1,101	1,157	1,215
31-33 Manufacturing	2,721	2,668	2,604	2,760	2,910	3,056	3,209
42 Wholesale trade	344	353	369	391	412	433	455
44-45 Retail trade	2,533	2,586	2,682	2,843	2,998	3,148	3,306
48-49 Transportation and warehousing	398	411	434	460	485	510	535
51 Information	309	318	332	352	372	390	410
52 Finance and insurance	515	530	555	588	620	651	684
53 Real estate and rental and leasing	169	178	193	205	216	227	238
54 Professional and technical services	736	806	915	970	1,023	1,074	1,128
55 Management of companies and enterprises	49	49	49	51	54	57	60
56 Administrative and waste services	1,135	1,222	1,362	1,444	1,523	1,599	1,679
61 Educational services	2,474	2,591	2,784	2,951	3,111	3,267	3,431
62 Health care and social assistance	2,368	2,522	2,769	2,935	3,095	3,250	3,413
71 Arts, entertainment, and recreation	206	228	263	279	294	309	324
72 Accommodation and food services	2,296	2,427	2,639	2,798	2,950	3,098	3,253
81 Other services, except public administration	470	487	515	546	576	605	635
92 Public Administration	2,507	2,603	2,764	2,930	3,089	3,244	3,407
99 Unclassified	2	2	2	2	2	2	2
Public-Supply Nonresidential Including System Losses (AFY)	2,761	2,869	3,049	3,233	3,408	3,579	3,759
Public-Supply Residential Including System Losses (AFY)	3,129	3,191	3,410	3,616	3,812	4,003	4,204
Self-Supply Residential (AFY)	1,253	1,279	1,366	1,449	1,527	1,604	1,684
Projection of Irrigated Lands (in Acres)	1,403	1,477	1,723	1,968	2,214	2,403	2,706
Crop Irrigation (AFY)	1,881	1,980	2,309	2,639	2,969	3,222	3,628
Livestock (AFY)	946	947	950	954	957	960	964
Oil and Gas Drilling (AFY)	214	320	613	997	1,470	2,034	2,689
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	651	639	623	661	697	732	768
Total Water Demand, All Sectors (AFY)*	**10,835**	**11,225**	**12,322**	**13,547**	**14,839**	**16,134**	**17,695**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Pushmataha	2007	2010	2020	2030	2040	2050	2060
Population, Total	11,666	12,055	13,632	15,116	16,692	18,454	20,216
Public-Supplied Population	10,126	10,464	11,832	13,120	14,489	16,018	17,547
Self-Supplied Population	1,540	1,591	1,800	1,995	2,203	2,436	2,669
Employment, Total	3,127	3,266	3,513	3,895	4,301	4,755	5,209
11 Agriculture, forestry, fishing and hunting	40	40	42	46	51	56	62
21 Mining, quarrying, and oil and gas extraction	0	0	0	0	0	0	0
22 Utilities	60	62	64	71	79	87	95
23 Construction	236	251	277	307	339	375	410
31-33 Manufacturing	200	196	192	213	235	260	285
42 Wholesale trade	57	59	61	68	75	83	91
44-45 Retail trade	365	373	388	431	476	526	576
48-49 Transportation and warehousing	62	64	68	75	83	92	101
51 Information	48	49	52	58	64	70	77
52 Finance and insurance	83	85	90	100	110	122	133
53 Real estate and rental and leasing	13	14	15	17	18	20	22
54 Professional and technical services	27	30	34	37	41	46	50
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	3	3	4	4	4	5	5
61 Educational services	518	542	585	649	717	793	868
62 Health care and social assistance	909	968	1,068	1,184	1,308	1,446	1,584
71 Arts, entertainment, and recreation	34	38	44	49	54	59	65
72 Accommodation and food services	140	148	162	180	199	220	240
81 Other services, except public administration	68	70	75	83	92	101	111
92 Public Administration	263	273	292	324	357	395	433
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	405	424	457	507	560	619	678
Public-Supply Residential Including System Losses (AFY)	667	689	780	865	955	1,055	1,156
Self-Supply Residential (AFY)	86	89	101	112	123	136	149
Projection of Irrigated Lands (in Acres)	524	525	527	530	533	535	538
Crop Irrigation (AFY)	814	816	820	824	828	831	836
Livestock (AFY)	493	495	502	510	518	525	533
Oil and Gas Drilling (AFY)	10	14	19	25	32	39	48
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**2,476**	**2,527**	**2,679**	**2,842**	**3,015**	**3,206**	**3,400**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Roger Mills	2007	2010	2020	2030	2040	2050	2060
Population, Total	3,308	3,308	3,308	3,308	3,308	3,308	3,308
Public-Supplied Population	2,628	2,628	2,628	2,628	2,628	2,628	2,628
Self-Supplied Population	680	680	680	680	680	680	680
Employment, Total	826	858	906	906	906	906	906
11 Agriculture, forestry, fishing and hunting	12	12	12	12	12	12	12
21 Mining, quarrying, and oil and gas extraction	75	77	80	80	80	80	80
22 Utilities	7	7	7	7	7	7	7
23 Construction	26	27	30	30	30	30	30
31-33 Manufacturing	43	42	41	41	41	41	41
42 Wholesale trade	15	15	16	16	16	16	16
44-45 Retail trade	103	105	108	108	108	108	108
48-49 Transportation and warehousing	115	119	125	125	125	125	125
51 Information	13	13	14	14	14	14	14
52 Finance and insurance	32	33	34	34	34	34	34
53 Real estate and rental and leasing	0	0	0	0	0	0	0
54 Professional and technical services	20	22	25	25	25	25	25
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	0	0	0	0	0	0	0
61 Educational services	136	142	152	152	152	152	152
62 Health care and social assistance	92	98	107	107	107	107	107
71 Arts, entertainment, and recreation	6	7	8	8	8	8	8
72 Accommodation and food services	40	42	46	46	46	46	46
81 Other services, except public administration	7	7	8	8	8	8	8
92 Public Administration	86	89	94	94	94	94	94
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	140	145	153	153	153	153	153
Public-Supply Residential Including System Losses (AFY)	473	473	473	473	473	473	473
Self-Supply Residential (AFY)	104	104	104	104	104	104	104
Projection of Irrigated Lands (in Acres)	4,605	4,607	4,615	4,622	4,630	4,636	4,645
Crop Irrigation (AFY)	9,262	9,266	9,281	9,296	9,312	9,323	9,342
Livestock (AFY)	863	871	896	921	946	971	996
Oil and Gas Drilling (AFY)	734	1,040	1,513	2,081	2,747	3,508	4,366
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**11,576**	**11,899**	**12,419**	**13,028**	**13,734**	**14,532**	**15,433**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Rogers	2007	2010	2020	2030	2040	2050	2060
Population, Total	83,105	86,272	96,934	106,089	114,598	123,322	132,261
Public-Supplied Population	77,525	80,479	90,426	98,966	106,903	115,042	123,381
Self-Supplied Population	5,580	5,793	6,509	7,123	7,695	8,280	8,881
Employment, Total	23,822	24,667	26,219	28,695	30,996	33,356	35,774
11 Agriculture, forestry, fishing and hunting	57	58	60	65	71	76	82
21 Mining, quarrying, and oil and gas extraction	206	212	224	245	265	285	306
22 Utilities	302	309	322	353	381	410	440
23 Construction	1,934	2,057	2,265	2,479	2,677	2,881	3,090
31-33 Manufacturing	4,932	4,835	4,742	5,190	5,606	6,033	6,470
42 Wholesale trade	1,025	1,052	1,105	1,209	1,306	1,406	1,508
44-45 Retail trade	2,176	2,222	2,315	2,534	2,737	2,945	3,159
48-49 Transportation and warehousing	1,240	1,281	1,359	1,487	1,607	1,729	1,854
51 Information	189	194	204	223	241	259	278
52 Finance and insurance	494	508	535	585	632	681	730
53 Real estate and rental and leasing	217	229	249	273	294	317	340
54 Professional and technical services	500	547	625	683	738	795	852
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	1,360	1,465	1,641	1,795	1,939	2,087	2,238
61 Educational services	3,120	3,267	3,527	3,860	4,170	4,487	4,812
62 Health care and social assistance	2,126	2,264	2,498	2,734	2,953	3,178	3,408
71 Arts, entertainment, and recreation	617	684	792	867	937	1,008	1,081
72 Accommodation and food services	1,584	1,674	1,830	2,002	2,163	2,328	2,496
81 Other services, except public administration	363	376	400	437	473	509	545
92 Public Administration	1,350	1,402	1,496	1,637	1,768	1,903	2,041
99 Unclassified	31	31	31	34	37	40	43
Public-Supply Nonresidential Including System Losses (AFY)	3,503	3,630	3,862	4,227	4,566	4,914	5,270
Public-Supply Residential Including System Losses (AFY)	9,389	9,746	10,951	11,985	12,947	13,932	14,942
Self-Supply Residential (AFY)	579	601	675	739	798	859	922
Projection of Irrigated Lands (in Acres)	811	833	904	976	1,048	1,103	1,191
Crop Irrigation (AFY)	1,470	1,509	1,639	1,769	1,900	1,999	2,160
Livestock (AFY)	1,116	1,119	1,127	1,134	1,142	1,150	1,158
Oil and Gas Drilling (AFY)	109	158	262	395	555	744	961
Thermoelectric, Withdrawals (AFY)	22,905	23,669	26,405	29,458	32,863	36,662	40,901
Thermoelectric, Consumptive Use (AFY)	14,186	14,659	16,354	18,245	20,354	22,707	25,332
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**39,070**	**40,432**	**44,922**	**49,708**	**54,771**	**60,261**	**66,312**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Seminole	2007	2010	2020	2030	2040	2050	2060
Population, Total	24,179	24,353	25,126	25,803	26,479	27,252	28,025
Public-Supplied Population	20,199	20,344	20,990	21,555	22,120	22,766	23,412
Self-Supplied Population	3,980	4,009	4,136	4,247	4,359	4,486	4,613
Employment, Total	7,549	7,827	8,269	8,491	8,714	8,968	9,223
11 Agriculture, forestry, fishing and hunting	28	28	29	30	31	32	32
21 Mining, quarrying, and oil and gas extraction	727	749	785	806	827	851	875
22 Utilities	184	188	195	200	205	211	217
23 Construction	350	372	407	418	428	441	453
31-33 Manufacturing	1,048	1,027	1,000	1,027	1,054	1,084	1,115
42 Wholesale trade	153	157	164	168	172	177	183
44-45 Retail trade	802	819	847	869	892	918	944
48-49 Transportation and warehousing	235	243	256	263	269	277	285
51 Information	51	53	55	57	58	60	62
52 Finance and insurance	189	194	203	209	214	220	226
53 Real estate and rental and leasing	45	48	51	53	54	56	57
54 Professional and technical services	83	91	103	106	108	112	115
55 Management of companies and enterprises	0	0	0	0	0	0	0
56 Administrative and waste services	63	68	76	78	80	82	84
61 Educational services	700	733	785	806	827	851	876
62 Health care and social assistance	1,529	1,628	1,782	1,830	1,878	1,933	1,988
71 Arts, entertainment, and recreation	85	94	108	111	114	117	120
72 Accommodation and food services	486	514	557	572	587	604	621
81 Other services, except public administration	121	125	132	136	139	143	147
92 Public Administration	660	685	726	745	765	787	809
99 Unclassified	10	10	10	10	11	11	11
Public-Supply Nonresidential Including System Losses (AFY)	1,411	1,461	1,540	1,582	1,623	1,671	1,718
Public-Supply Residential Including System Losses (AFY)	1,331	1,341	1,383	1,420	1,458	1,500	1,543
Self-Supply Residential (AFY)	223	225	232	238	244	251	258
Projection of Irrigated Lands (in Acres)	782	831	993	1,155	1,317	1,441	1,641
Crop Irrigation (AFY)	1,250	1,328	1,587	1,847	2,106	2,305	2,624
Livestock (AFY)	623	627	642	656	671	686	700
Oil and Gas Drilling (AFY)	299	437	757	1,167	1,667	2,257	2,938
Thermoelectric, Withdrawals (AFY)	17,320	17,898	19,967	22,275	24,851	27,723	30,929
Thermoelectric, Consumptive Use (AFY)	10,727	11,085	12,367	13,796	15,391	17,171	19,156
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**22,457**	**23,316**	**26,108**	**29,185**	**32,619**	**36,393**	**40,710**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Sequoyah	2007	2010	2020	2030	2040	2050	2060
Population, Total	41,024	42,368	46,946	51,231	55,419	59,705	63,990
Public-Supplied Population	40,204	41,521	46,007	50,207	54,312	58,512	62,711
Self-Supplied Population	820	847	938	1,024	1,108	1,193	1,279
Employment, Total	9,156	9,577	10,306	11,247	12,167	13,108	14,048
11 Agriculture, forestry, fishing and hunting	61	62	64	69	75	81	87
21 Mining, quarrying, and oil and gas extraction	57	59	62	68	73	79	85
22 Utilities	93	95	99	108	117	126	135
23 Construction	204	217	239	260	282	303	325
31-33 Manufacturing	646	633	620	677	732	789	845
42 Wholesale trade	118	121	127	139	150	162	173
44-45 Retail trade	1,164	1,188	1,237	1,350	1,460	1,573	1,686
48-49 Transportation and warehousing	343	355	376	410	443	478	512
51 Information	64	66	69	75	82	88	94
52 Finance and insurance	364	374	394	430	465	501	537
53 Real estate and rental and leasing	52	55	60	65	70	76	81
54 Professional and technical services	237	259	296	323	349	376	403
55 Management of companies and enterprises	23	23	23	25	27	29	31
56 Administrative and waste services	435	469	524	572	619	667	715
61 Educational services	1,386	1,451	1,565	1,707	1,847	1,990	2,133
62 Health care and social assistance	1,998	2,128	2,344	2,558	2,767	2,981	3,195
71 Arts, entertainment, and recreation	292	323	374	409	442	476	510
72 Accommodation and food services	938	991	1,082	1,181	1,277	1,376	1,475
81 Other services, except public administration	83	86	91	100	108	116	124
92 Public Administration	597	620	661	721	780	841	901
99 Unclassified	1	1	1	1	1	1	1
Public-Supply Nonresidential Including System Losses (AFY)	1,325	1,393	1,509	1,647	1,782	1,919	2,057
Public-Supply Residential Including System Losses (AFY)	5,797	5,987	6,634	7,239	7,831	8,436	9,042
Self-Supply Residential (AFY)	100	104	115	126	136	146	157
Projection of Irrigated Lands (in Acres)	1,622	1,649	1,740	1,831	1,921	1,991	2,103
Crop Irrigation (AFY)	2,184	2,221	2,343	2,465	2,587	2,681	2,832
Livestock (AFY)	721	730	758	787	816	845	873
Oil and Gas Drilling (AFY)	40	57	78	102	129	160	194
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	1,742	1,708	1,672	1,825	1,974	2,127	2,280
Total Water Demand, All Sectors (AFY)*	**11,910**	**12,198**	**13,109**	**14,191**	**15,255**	**16,315**	**17,434**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Stephens	2007	2010	2020	2030	2040	2050	2060
Population, Total	43,322	43,322	43,827	44,231	44,736	45,443	46,352
Public-Supplied Population	36,702	36,702	37,130	37,472	37,900	38,499	39,269
Self-Supplied Population	6,620	6,620	6,697	6,759	6,836	6,944	7,083
Employment, Total	15,505	16,032	16,846	17,002	17,196	17,467	17,817
11 Agriculture, forestry, fishing and hunting	16	16	17	17	17	17	18
21 Mining, quarrying, and oil and gas extraction	1,863	1,920	2,008	2,026	2,049	2,082	2,123
22 Utilities	107	109	113	114	115	117	120
23 Construction	836	889	970	978	990	1,005	1,025
31-33 Manufacturing	2,562	2,512	2,440	2,462	2,490	2,530	2,580
42 Wholesale trade	396	406	423	427	432	438	447
44-45 Retail trade	2,098	2,142	2,211	2,231	2,257	2,292	2,338
48-49 Transportation and warehousing	686	709	745	751	760	772	787
51 Information	134	138	144	145	147	149	152
52 Finance and insurance	585	602	627	633	640	651	664
53 Real estate and rental and leasing	84	89	96	96	97	99	101
54 Professional and technical services	340	371	420	424	429	435	444
55 Management of companies and enterprises	42	42	41	42	42	43	44
56 Administrative and waste services	570	614	681	688	695	706	720
61 Educational services	1,284	1,345	1,438	1,451	1,468	1,491	1,521
62 Health care and social assistance	1,802	1,919	2,097	2,116	2,140	2,174	2,218
71 Arts, entertainment, and recreation	168	186	214	216	218	222	226
72 Accommodation and food services	965	1,020	1,104	1,114	1,127	1,145	1,168
81 Other services, except public administration	320	331	349	352	356	362	369
92 Public Administration	643	668	706	712	720	732	746
99 Unclassified	5	5	5	5	5	5	5
Public-Supply Nonresidential Including System Losses (AFY)	3,037	3,135	3,287	3,317	3,355	3,408	3,476
Public-Supply Residential Including System Losses (AFY)	5,435	5,435	5,498	5,549	5,612	5,701	5,815
Self-Supply Residential (AFY)	833	833	843	851	860	874	892
Projection of Irrigated Lands (in Acres)	1,194	1,312	1,703	2,095	2,487	2,788	3,271
Crop Irrigation (AFY)	2,031	2,231	2,898	3,564	4,231	4,742	5,564
Livestock (AFY)	1,012	1,019	1,044	1,068	1,093	1,117	1,142
Oil and Gas Drilling (AFY)	500	707	1,017	1,388	1,820	2,313	2,866
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**12,848**	**13,360**	**14,586**	**15,737**	**16,971**	**18,155**	**19,755**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Texas	2007	2010	2020	2030	2040	2050	2060
Population, Total	20,032	21,557	26,802	32,130	37,458	42,785	48,031
Public-Supplied Population	17,432	18,759	23,324	27,960	32,596	37,232	41,797
Self-Supplied Population	2,600	2,798	3,479	4,170	4,862	5,553	6,234
Employment, Total	6,475	6,741	7,283	8,730	10,178	11,626	13,051
11 Agriculture, forestry, fishing and hunting	635	644	671	805	938	1,072	1,203
21 Mining, quarrying, and oil and gas extraction	107	110	117	141	164	187	210
22 Utilities	157	161	170	203	237	271	304
23 Construction	552	587	652	782	911	1,041	1,168
31-33 Manufacturing	200	196	194	233	271	310	348
42 Wholesale trade	296	304	322	386	450	514	577
44-45 Retail trade	744	760	799	957	1,116	1,275	1,431
48-49 Transportation and warehousing	139	144	154	184	215	245	276
51 Information	227	234	248	297	347	396	444
52 Finance and insurance	230	237	251	301	351	401	450
53 Real estate and rental and leasing	37	39	43	51	60	68	77
54 Professional and technical services	181	198	228	273	319	364	409
55 Management of companies and enterprises	35	35	35	42	49	56	63
56 Administrative and waste services	240	258	292	350	408	466	523
61 Educational services	976	1,022	1,113	1,335	1,556	1,777	1,995
62 Health care and social assistance	417	444	494	592	690	788	885
71 Arts, entertainment, and recreation	70	78	91	109	127	145	163
72 Accommodation and food services	706	746	822	986	1,149	1,313	1,473
81 Other services, except public administration	120	124	133	160	186	213	239
92 Public Administration	401	416	448	537	626	716	803
99 Unclassified	5	5	5	6	7	8	9
Public-Supply Nonresidential Including System Losses (AFY)	898	938	1,016	1,218	1,420	1,622	1,821
Public-Supply Residential Including System Losses (AFY)	2,678	2,882	3,583	4,295	5,007	5,719	6,421
Self-Supply Residential (AFY)	339	365	454	545	635	725	814
Projection of Irrigated Lands (in Acres)	156,026	156,340	157,386	158,431	159,477	160,280	161,569
Crop Irrigation (AFY)	199,312	199,713	201,049	202,385	203,721	204,747	206,393
Livestock (AFY)	9,133	9,161	9,254	9,347	9,440	9,533	9,626
Oil and Gas Drilling (AFY)	607	870	1,346	1,935	2,639	3,456	4,387
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	10,938	10,724	10,612	12,722	14,831	16,941	19,018
Total Water Demand, All Sectors (AFY)*	**223,906**	**224,653**	**227,314**	**232,447**	**237,694**	**242,743**	**248,480**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Tillman	2007	2010	2020	2030	2040	2050	2060
Population, Total	8,148	8,148	8,325	8,502	8,679	8,857	9,122
Public-Supplied Population	7,478	7,478	7,641	7,803	7,966	8,128	8,372
Self-Supplied Population	670	670	685	699	714	728	750
Employment, Total	2,173	2,259	2,393	2,444	2,495	2,546	2,622
11 Agriculture, forestry, fishing and hunting	105	107	109	111	114	116	119
21 Mining, quarrying, and oil and gas extraction	26	27	28	29	30	30	31
22 Utilities	86	88	91	93	95	97	100
23 Construction	108	115	126	129	131	134	138
31-33 Manufacturing	151	149	144	147	151	154	158
42 Wholesale trade	79	81	84	86	88	90	92
44-45 Retail trade	176	180	186	190	194	197	203
48-49 Transportation and warehousing	64	66	69	71	72	74	76
51 Information	42	43	45	45	46	47	49
52 Finance and insurance	106	109	114	117	119	121	125
53 Real estate and rental and leasing	4	4	5	5	5	5	5
54 Professional and technical services	32	35	40	40	41	42	43
55 Management of companies and enterprises	16	16	16	16	16	16	17
56 Administrative and waste services	48	52	58	59	60	61	63
61 Educational services	320	335	358	366	373	381	392
62 Health care and social assistance	246	262	286	292	298	304	313
71 Arts, entertainment, and recreation	42	47	54	55	56	57	59
72 Accommodation and food services	173	183	198	203	207	211	217
81 Other services, except public administration	39	40	43	43	44	45	47
92 Public Administration	309	321	339	347	354	361	372
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	309	322	343	350	357	364	375
Public-Supply Residential Including System Losses (AFY)	1,023	1,023	1,046	1,068	1,090	1,112	1,146
Self-Supply Residential (AFY)	80	80	81	83	85	87	89
Projection of Irrigated Lands (in Acres)	12,974	13,028	13,206	13,385	13,563	13,700	13,920
Crop Irrigation (AFY)	18,089	18,163	18,412	18,661	18,910	19,101	19,408
Livestock (AFY)	888	889	895	900	905	911	916
Oil and Gas Drilling (AFY)	27	41	75	121	177	243	319
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**20,415**	**20,518**	**20,852**	**21,183**	**21,524**	**21,818**	**22,254**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Tulsa	2007	2010	2020	2030	2040	2050	2060
Population, Total	585,068	595,326	627,632	654,571	673,557	687,970	701,986
Public-Supplied Population	576,128	586,230	618,042	644,569	663,265	677,458	691,260
Self-Supplied Population	8,940	9,097	9,590	10,002	10,292	10,512	10,727
Employment, Total	341,500	355,930	379,487	395,775	407,255	415,969	424,444
11 Agriculture, forestry, fishing and hunting	419	425	437	455	469	479	488
21 Mining, quarrying, and oil and gas extraction	4,681	4,824	5,063	5,281	5,434	5,550	5,663
22 Utilities	3,224	3,296	3,422	3,569	3,672	3,751	3,828
23 Construction	17,565	18,676	20,445	21,322	21,941	22,410	22,867
31-33 Manufacturing	38,052	37,306	36,371	37,932	39,032	39,867	40,679
42 Wholesale trade	15,705	16,121	16,829	17,552	18,061	18,447	18,823
44-45 Retail trade	37,377	38,160	39,533	41,229	42,425	43,333	44,216
48-49 Transportation and warehousing	17,931	18,536	19,543	20,382	20,973	21,422	21,858
51 Information	9,914	10,189	10,655	11,112	11,434	11,679	11,917
52 Finance and insurance	14,720	15,138	15,845	16,525	17,004	17,368	17,722
53 Real estate and rental and leasing	7,525	7,932	8,587	8,955	9,215	9,412	9,604
54 Professional and technical services	19,196	21,004	23,835	24,858	25,579	26,127	26,659
55 Management of companies and enterprises	5,901	5,870	5,854	6,105	6,282	6,417	6,547
56 Administrative and waste services	33,682	36,288	40,400	42,134	43,356	44,284	45,186
61 Educational services	21,953	22,991	24,672	25,731	26,478	27,044	27,595
62 Health care and social assistance	41,810	44,521	48,833	50,929	52,406	53,528	54,618
71 Arts, entertainment, and recreation	4,751	5,265	6,067	6,327	6,511	6,650	6,785
72 Accommodation and food services	27,964	29,558	32,111	33,489	34,460	35,198	35,915
81 Other services, except public administration	9,395	9,730	10,285	10,726	11,037	11,274	11,503
92 Public Administration	9,525	9,890	10,491	10,942	11,259	11,500	11,734
99 Unclassified	210	210	211	220	227	231	236
Public-Supply Nonresidential Including System Losses (AFY)	43,051	44,846	47,779	49,830	51,275	52,372	53,439
Public-Supply Residential Including System Losses (AFY)	64,076	65,199	68,737	71,687	73,767	75,345	76,880
Self-Supply Residential (AFY)	903	919	969	1,010	1,040	1,062	1,084
Projection of Irrigated Lands (in Acres)	3,901	3,941	4,075	4,208	4,342	4,444	4,609
Crop Irrigation (AFY)	7,427	7,503	7,757	8,012	8,266	8,461	8,775
Livestock (AFY)	337	338	341	345	349	352	356
Oil and Gas Drilling (AFY)	89	128	211	316	443	592	763
Thermoelectric, Withdrawals (AFY)	13,071	13,507	15,069	16,811	18,754	20,922	23,341
Thermoelectric, Consumptive Use (AFY)	8,096	8,366	9,333	10,412	11,615	12,958	14,456
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**128,952**	**132,440**	**140,864**	**148,011**	**153,893**	**159,107**	**164,638**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Wagoner	2007	2010	2020	2030	2040	2050	2060
Population, Total	67,239	69,679	77,814	84,557	90,765	96,866	103,288
Public-Supplied Population	67,239	69,679	77,814	84,557	90,765	96,866	103,288
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	6,804	7,057	7,512	8,163	8,763	9,352	9,972
11 Agriculture, forestry, fishing and hunting	67	68	70	76	82	87	93
21 Mining, quarrying, and oil and gas extraction	17	18	18	20	22	23	25
22 Utilities	33	34	35	38	41	44	47
23 Construction	603	641	705	766	823	878	936
31-33 Manufacturing	1,226	1,202	1,178	1,280	1,374	1,466	1,564
42 Wholesale trade	154	158	166	180	193	206	220
44-45 Retail trade	782	798	831	903	970	1,035	1,104
48-49 Transportation and warehousing	107	111	117	127	137	146	156
51 Information	39	40	42	46	49	52	56
52 Finance and insurance	208	214	225	245	263	280	299
53 Real estate and rental and leasing	49	52	56	61	66	70	75
54 Professional and technical services	226	247	282	307	329	351	374
55 Management of companies and enterprises	5	5	5	5	6	6	6
56 Administrative and waste services	149	161	180	195	210	224	239
61 Educational services	1,002	1,050	1,132	1,230	1,321	1,409	1,503
62 Health care and social assistance	886	943	1,040	1,130	1,213	1,294	1,380
71 Arts, entertainment, and recreation	85	94	109	119	127	136	145
72 Accommodation and food services	641	678	740	804	863	921	982
81 Other services, except public administration	142	147	156	170	182	195	207
92 Public Administration	373	388	413	449	482	515	549
99 Unclassified	10	10	10	11	12	13	13
Public-Supply Nonresidential Including System Losses (AFY)	987	1,023	1,088	1,182	1,269	1,354	1,444
Public-Supply Residential Including System Losses (AFY)	7,121	7,379	8,241	8,955	9,612	10,259	10,939
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	5,226	5,226	5,226	5,226	5,226	5,226	5,226
Crop Irrigation (AFY)	8,392	8,392	8,392	8,392	8,392	8,392	8,392
Livestock (AFY)	639	640	642	645	647	649	652
Oil and Gas Drilling (AFY)	81	118	201	307	436	588	763
Thermoelectric, Withdrawals (AFY)	4,580	4,733	5,280	5,891	6,572	7,332	8,179
Thermoelectric, Consumptive Use (AFY)	2,837	2,932	3,270	3,648	4,070	4,541	5,066
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**21,800**	**22,285**	**23,844**	**25,371**	**26,928**	**28,574**	**30,369**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Washington	2007	2010	2020	2030	2040	2050	2060
Population, Total	49,888	50,130	51,240	51,744	52,450	53,156	53,963
Public-Supplied Population	49,888	50,130	51,240	51,744	52,450	53,156	53,963
Self-Supplied Population	0	0	0	0	0	0	0
Employment, Total	19,510	20,352	21,659	21,872	22,170	22,469	22,810
11 Agriculture, forestry, fishing and hunting	12	12	12	13	13	13	13
21 Mining, quarrying, and oil and gas extraction	3,155	3,251	3,402	3,436	3,482	3,529	3,583
22 Utilities	268	274	284	286	290	294	299
23 Construction	589	626	684	690	700	709	720
31-33 Manufacturing	740	725	705	712	722	732	743
42 Wholesale trade	277	284	296	299	303	307	312
44-45 Retail trade	3,518	3,592	3,709	3,746	3,797	3,848	3,907
48-49 Transportation and warehousing	249	257	271	273	277	281	285
51 Information	159	164	171	172	175	177	180
52 Finance and insurance	648	666	695	702	712	721	732
53 Real estate and rental and leasing	184	194	209	211	214	217	220
54 Professional and technical services	620	678	767	775	786	796	808
55 Management of companies and enterprises	100	99	99	100	101	103	104
56 Administrative and waste services	1,410	1,519	1,686	1,703	1,726	1,749	1,776
61 Educational services	1,571	1,645	1,760	1,777	1,802	1,826	1,854
62 Health care and social assistance	2,954	3,146	3,440	3,474	3,521	3,569	3,623
71 Arts, entertainment, and recreation	222	246	283	285	289	293	298
72 Accommodation and food services	1,691	1,787	1,936	1,955	1,982	2,008	2,039
81 Other services, except public administration	710	735	775	782	793	804	816
92 Public Administration	431	448	474	478	485	491	499
99 Unclassified	1	1	1	1	1	1	1
Public-Supply Nonresidential Including System Losses (AFY)	4,136	4,300	4,556	4,600	4,663	4,726	4,798
Public-Supply Residential Including System Losses (AFY)	7,603	7,639	7,809	7,885	7,993	8,101	8,224
Self-Supply Residential (AFY)	0	0	0	0	0	0	0
Projection of Irrigated Lands (in Acres)	497	538	675	812	950	1,055	1,224
Crop Irrigation (AFY)	530	574	721	867	1,014	1,126	1,306
Livestock (AFY)	535	536	539	541	544	547	550
Oil and Gas Drilling (AFY)	242	339	464	609	773	957	1,160
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**13,046**	**13,389**	**14,088**	**14,503**	**14,987**	**15,456**	**16,037**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Washita	2007	2010	2020	2030	2040	2050	2060
Population, Total	11,667	11,786	12,182	12,479	12,677	12,974	13,172
Public-Supplied Population	9,467	9,563	9,885	10,126	10,287	10,528	10,689
Self-Supplied Population	2,200	2,222	2,297	2,353	2,390	2,447	2,484
Employment, Total	2,287	2,380	2,528	2,589	2,630	2,692	2,733
11 Agriculture, forestry, fishing and hunting	27	27	28	29	29	30	30
21 Mining, quarrying, and oil and gas extraction	242	249	261	268	272	278	283
22 Utilities	25	26	27	27	28	29	29
23 Construction	193	205	224	229	233	238	242
31-33 Manufacturing	60	59	57	59	60	61	62
42 Wholesale trade	108	111	116	118	120	123	125
44-45 Retail trade	242	247	255	262	266	272	276
48-49 Transportation and warehousing	71	74	78	79	81	83	84
51 Information	31	32	34	35	35	36	36
52 Finance and insurance	106	109	114	117	119	121	123
53 Real estate and rental and leasing	100	105	114	117	119	121	123
54 Professional and technical services	42	46	52	53	54	55	56
55 Management of companies and enterprises	13	13	13	13	13	14	14
56 Administrative and waste services	25	27	30	31	31	32	33
61 Educational services	431	451	484	495	503	515	523
62 Health care and social assistance	175	186	204	209	212	217	221
71 Arts, entertainment, and recreation	0	0	0	0	0	0	0
72 Accommodation and food services	72	76	83	85	86	88	90
81 Other services, except public administration	28	29	31	31	32	33	33
92 Public Administration	295	306	324	332	338	345	351
99 Unclassified	0	0	0	0	0	0	0
Public-Supply Nonresidential Including System Losses (AFY)	391	406	430	440	447	458	465
Public-Supply Residential Including System Losses (AFY)	691	698	721	739	750	768	780
Self-Supply Residential (AFY)	142	144	148	152	154	158	161
Projection of Irrigated Lands (in Acres)	7,300	7,396	7,714	8,033	8,351	8,595	8,988
Crop Irrigation (AFY)	5,063	5,130	5,350	5,571	5,792	5,962	6,234
Livestock (AFY)	1,511	1,511	1,510	1,510	1,510	1,509	1,509
Oil and Gas Drilling (AFY)	556	830	1,569	2,535	3,726	5,143	6,786
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**8,354**	**8,717**	**9,729**	**10,947**	**12,380**	**13,998**	**15,934**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Woods	2007	2010	2020	2030	2040	2050	2060
Population, Total	8,319	8,374	8,374	8,465	8,556	8,647	8,829
Public-Supplied Population	7,209	7,256	7,256	7,335	7,414	7,493	7,651
Self-Supplied Population	1,110	1,117	1,117	1,129	1,142	1,154	1,178
Employment, Total	3,110	3,242	3,439	3,477	3,514	3,552	3,626
11 Agriculture, forestry, fishing and hunting	45	46	47	47	48	48	49
21 Mining, quarrying, and oil and gas extraction	73	75	79	79	80	81	83
22 Utilities	26	27	28	28	28	28	29
23 Construction	89	95	103	104	105	106	109
31-33 Manufacturing	186	182	177	179	181	183	186
42 Wholesale trade	94	96	100	101	102	103	106
44-45 Retail trade	466	476	490	496	501	506	517
48-49 Transportation and warehousing	91	94	98	99	100	101	104
51 Information	64	66	68	69	70	71	72
52 Finance and insurance	166	171	178	180	182	184	187
53 Real estate and rental and leasing	24	25	27	28	28	28	29
54 Professional and technical services	56	61	69	70	71	71	73
55 Management of companies and enterprises	10	10	10	10	10	11	11
56 Administrative and waste services	56	60	67	67	68	69	70
61 Educational services	317	332	354	358	362	366	374
62 Health care and social assistance	790	841	918	928	938	948	968
71 Arts, entertainment, and recreation	32	35	41	41	42	42	43
72 Accommodation and food services	225	238	257	260	263	265	271
81 Other services, except public administration	50	52	54	55	56	56	57
92 Public Administration	245	255	269	272	275	278	284
99 Unclassified	5	5	5	5	5	5	5
Public-Supply Nonresidential Including System Losses (AFY)	433	452	480	485	490	496	506
Public-Supply Residential Including System Losses (AFY)	2,692	2,709	2,709	2,739	2,768	2,798	2,857
Self-Supply Residential (AFY)	352	355	355	358	362	366	374
Projection of Irrigated Lands (in Acres)	1,984	2,023	2,154	2,285	2,416	2,517	2,678
Crop Irrigation (AFY)	3,288	3,353	3,570	3,787	4,005	4,171	4,439
Livestock (AFY)	1,339	1,347	1,374	1,401	1,428	1,455	1,482
Oil and Gas Drilling (AFY)	361	509	717	962	1,244	1,563	1,921
Thermoelectric, Withdrawals (AFY)	0	0	0	0	0	0	0
Thermoelectric, Consumptive Use (AFY)	0	0	0	0	0	0	0
Self-Supply Large Industry (AFY)	0	0	0	0	0	0	0
Total Water Demand, All Sectors (AFY)*	**8,466**	**8,726**	**9,205**	**9,733**	**10,297**	**10,849**	**11,577**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Woodward	2007	2010	2020	2030	2040	2050	2060
Population, Total	19,505	19,752	20,575	21,192	21,604	22,118	22,530
Public-Supplied Population	16,005	16,208	16,883	17,389	17,727	18,149	18,487
Self-Supplied Population	3,500	3,544	3,692	3,803	3,877	3,969	4,043
Employment, Total	9,378	9,756	10,364	10,675	10,882	11,141	11,348
11 Agriculture, forestry, fishing and hunting	167	169	174	179	183	187	190
21 Mining, quarrying, and oil and gas extraction	1,848	1,904	1,997	2,057	2,097	2,147	2,187
22 Utilities	230	235	243	251	256	262	267
23 Construction	663	705	771	794	809	829	844
31-33 Manufacturing	327	321	312	322	328	336	342
42 Wholesale trade	336	345	360	370	378	387	394
44-45 Retail trade	1,186	1,211	1,253	1,291	1,316	1,347	1,372
48-49 Transportation and warehousing	402	415	437	450	459	470	479
51 Information	84	87	91	93	95	97	99
52 Finance and insurance	394	405	424	436	445	455	464
53 Real estate and rental and leasing	126	133	144	148	151	154	157
54 Professional and technical services	179	196	222	229	233	239	243
55 Management of companies and enterprises	43	43	43	44	45	46	47
56 Administrative and waste services	382	411	458	471	480	492	501
61 Educational services	561	587	629	648	661	677	689
62 Health care and social assistance	1,042	1,109	1,215	1,252	1,276	1,307	1,331
71 Arts, entertainment, and recreation	63	70	80	83	84	86	88
72 Accommodation and food services	690	729	791	815	831	851	867
81 Other services, except public administration	298	309	326	336	342	350	357
92 Public Administration	356	370	392	403	411	421	429
99 Unclassified	2	2	2	2	2	2	2
Public-Supply Nonresidential Including System Losses (AFY)	1,982	2,055	2,174	2,239	2,282	2,337	2,380
Public-Supply Residential Including System Losses (AFY)	3,617	3,663	3,815	3,930	4,006	4,101	4,178
Self-Supply Residential (AFY)	723	732	763	786	801	820	835
Projection of Irrigated Lands (in Acres)	7,565	7,565	7,565	7,565	7,565	7,565	7,565
Crop Irrigation (AFY)	8,026	8,026	8,026	8,026	8,026	8,026	8,026
Livestock (AFY)	1,856	1,856	1,856	1,857	1,857	1,858	1,858
Oil and Gas Drilling (AFY)	434	609	834	1,093	1,388	1,717	2,081
Thermoelectric, Withdrawals (AFY)	514	531	593	661	738	823	918
Thermoelectric, Consumptive Use (AFY)	318	329	367	410	457	510	569
Self-Supply Large Industry (AFY)	3,159	3,097	3,016	3,106	3,167	3,242	3,303
Total Water Demand, All Sectors (AFY)*	**20,310**	**20,568**	**21,076**	**21,697**	**22,264**	**22,923**	**23,579**

***Total includes system losses for public-supply forecast and thermoelectric power withdrawals**

Oklahoma Comprehensive Water Plan
2012 Update

Water Demand Forecast Report Addendum

Conservation and Climate Change

August 2011

This study was funded through an agreement with the Oklahoma Water Resources Board under its authority to update the Oklahoma Comprehensive Water Plan, the state's long-range water planning strategy, due for submittal to the State Legislature in 2012. Results from this and other studies have been incorporated where appropriate in the OCWP's technical and policy considerations. The general goal of the OCWP is to ensure reliable water supplies for all Oklahomans through integrated and coordinated water resources planning and to provide information so that water providers, policy-makers, and water users can make informed decisions concerning the use and management of Oklahoma's water resources.

Prepared by CDM under a cooperative agreement between the
United States Army Corps of Engineers and the Oklahoma Water Resources Board

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Section 1
Introduction

In support of IDIQ Task Order Number 1 (W912BV-09-D-1001) for the development of the Oklahoma Comprehensive Water Plan (OCWP), Task 1A.8, Demand Projection Report, this report addendum serves as a supplement to the October 2009, Oklahoma Comprehensive Water Plan. This addendum includes refinements to demand projections based on Task 1A.5, Assessment of Conservation, and Task 2D.8, Investigate Climate Change "What if" Scenarios. This technical document describes the process of data collection and adoption of a reliable methodology for the assessment of both conservation and climate change scenarios. Additionally, new county-level demands are expressed as a result of each of these scenarios.

The demand for water is critical and is increasing due to population and economic growth. Rising demand combined with uncertainty of future supplies under potential climate change creates a critical need to maximize the use of an important and limited resource.

The demand forecast produced in Task 1 has been allocated to watershed basins to characterize any differences between water supply and water demand, thus identifying areas of potential water surplus and shortfalls, or gaps. This is in accordance with Task 2 of the OCWP Programmatic Work Plan. This report does not include information on the basin-level forecasts. Those forecasts are documented in the Demand/Supply Gap report.

Section 2
Conservation

2.1 Introduction

In support of task order W912BV-09-D-1001 for the development of the Oklahoma Comprehensive Water Plan (OCWP), Task 1A.5, Assessment of Conservation, CDM developed the proposed conservation scenarios that are applied to the previously developed baseline forecast for the Municipal and Industrial (M&I) and self-supplied residential and agriculture sectors of the OCWP. Demand scenarios with conservation were developed based on patterns of current conservation and factors affecting future conservation activities occurring throughout the state. These factors include cost-effectiveness of potential programs, ease of implementation, and acceptance by both the citizens of Oklahoma and water provider decision makers.

Water conservation is being recognized as an important tool in managing water resources. In addition to providing decreased cost to water providers and reductions in customer water bills, the water saved through conservation programs has been shown to help reduce or avoid the demand for water restrictions during periods of drought. Conservation can be implemented on both the demand and supply/distribution side of water management. Distribution conservation involves the effective management of system water losses through metering, analysis of water use, and leak detection in order to identify sources of non-revenue water. Municipal and industrial supply side conservation techniques reduce water demand by changing consumer behavior through: implementing education programs, promoting the use of water efficient appliances through voucher, rebates or plumbing codes, and employing conservation pricing (Sturm and Thornton). Agricultural supply side conservation reduce water demand through activities such as implementation of irrigation systems with increased efficiencies and production of crops with decreased water requirements.

Reductions in water demand diminish the amount of water required by end users while supply side leak detection reduces water loss in a system. Both approaches can reduce the volume of water utilities produce, helping decrease operation and maintenance expenses. Reduced water demand from conservation also prolongs the lifespan of current supplies; allowing utilities to defer, down size, or even eliminate costly investment in new facilities and water supplies (Maddaus 1999). Customers also benefit from conservation through reduced water and energy utility bills. Reductions in energy use for residential customers largely come from conserving hot water used by household appliances. Heating water for washing machines, dishwashers, and showers is the biggest water related energy use for residential users as well as many commercial users (Teliinghuisen 2009). Other significant benefits that are difficult to quantify can include lower discharge of treated wastewater into receiving waters, more water available for the environment, and the creation of water conservation jobs (Maddaus 1999). Within this section of this addendum, a brief cost-benefit analysis of conservation activities will be addressed. Conservation costs evaluated will include costs to customers, and costs to utilities including capital and operation and maintenance, administration and implementation.

CDM evaluated the impact of statewide expansion of a number of basic conservation activities to all Oklahoma water providers as well as implementation of a statewide water efficient indoor plumbing code ordinance that improves upon the current U.S. standards. Agricultural conservation activities

evaluated included dryland production, increased irrigation efficiencies, and crop shifting. Conservation scenarios were developed through a combination of the activities.

2.2 Residential and Public-Supply Industrial Conservation

In order to provide useful and realistic conservation scenarios for the OCWP, and to assess the potential for conservation in Oklahoma, a comprehensive analysis was conducted identifying current conservation activities occurring at the provider-level throughout the state. Information on conservation activities were gathered from available resources including:

- Provider survey administered in May 2008 by OWRB with assistance from the Oklahoma Rural Water Association (ORWA) and the Oklahoma Municipal League (OML)
- Water provider websites
- Water provider conservation, supply, and drought response plans (as available)
- Oklahoma Water Resources Research Institute (OWRRI) 2009 Annual Report
- 2010 Oklahoma Academy Town Hall Water Final Report
- 2009 Alternative Water Conservation Policy Tools for Oklahoma Water Systems (conducted by OSU)
- 2002 U.S. Army Corps of Engineers (USACE) State of Oklahoma Water Resource Database

One of the main goals of this study is to build on current successful conservation activities which are being implemented by individual water providers in the state. In order to achieve this goal, the conservation matrix was utilized as an essential tool for determining potential future conservation activities. Analysis of the matrix database resulted in percentages of water providers currently practicing specific conservation activities for a given county. Analysis of the matrix revealed that water providers in Edmond and Norman are implementing progressive water conservation activities including educational programs for children and adults, a conservation website complete with water saving tips, leak detection measures, commercial and residential meters, water supply plan, water conservation plan, drought management plan, reclaimed water use for irrigation purposes, an increasing tiered rate water billing structure (often referred to as conservation rates), and summer watering schedules. These fundamental programs were used to form the basis of future conservation goals throughout the state. Thus, it is logical that a realistic assessment of potential conservation savings includes these fundamental activities and builds accordingly.

2.2.1 Conservation Activities

For the purpose of this report, conservation activities are actions performed in an effort to save water. These actions can include behavioral changes or installation of conservation devices used to conserve water. These activities can be implemented at a variety of levels including the state level, by the water provider, or by the water customer. Estimated water savings associated with the following conservation activities can be viewed in Appendix A at the end of this report.

Passive Conservation

In order to achieve an accurate estimate of current conservation savings throughout the state, passive conservation savings must be taken into account. Passive conservation involves water savings that are the direct result of state and federal implementation of plumbing codes requiring individuals to install water efficient plumbing fixtures. Prior to 1980, most toilets used 5.0 gallons per flush (gpf). After 1980, toilets installed in new and remodeled homes were primarily 3.5 gpf toilets. In 1994, however, as a result of the U.S. Energy Policy Act (Energy Act) of 1992, national plumbing codes mandated a maximum flush rate of 1.6 gpf (also called Ultra Low Flow Toilets or ULFT) for new and remodeled homes. Standards were also set for faucets (2.5 gallons per minute (gpm)), showerheads (2.5 gpm), and urinals (1.0 gpf). It is estimated that the Energy Act will reduce indoor water use in the average home from 121 to 55 gallons per day (gpd) by 2026 (Vickers 1993).

Passive conservation savings apply to the public-supplied residential (PSR), public-supplied nonresidential (PSNR), and self-supplied residential (SSR) sectors. PSNR savings were estimated using employment data from the 2000 Census, while PSR and SSR savings were estimated using housing data from the 2000 Census ("year structure build"), as well as data on the average replacement rates of toilets and other indoor fixtures. Passive conservation savings and new demands with such savings were calculated on a county basis. Savings are a result of older, less efficient fixtures being replaced with maximum rate fixtures, as well as installation of maximum rate fixtures in new construction.

The methodology for estimating passive savings for the PSR and SSR builds upon the Vicker's assumption that the Energy Act will reduce indoor water use in the average home from 121 gpd in 1994 to 55 gpd by 2026. Indoor use estimate is interpolated from 1994 to 2026. Savings are then estimated from 2007, which is the base year of the forecast (i.e., the water use factors developed for the baseline forecast were generally developed using 2007 data). Per household savings are multiplied by the number of housing units in the county to determine the total savings, as shown in Equation 1 through Equation 3.

$$Sp_Y^C = (H_Y^C \times Sph_Y^C \times 365) \div 325{,}851 \qquad \textbf{Equation 1}$$

$$Sph_Y^C = IU_Y^C - IU_{Y2007}^C \qquad \textbf{Equation 2}$$

$$IU_Y^C = \left\{\left((55 - 121) \div (2026 - 1994)\right) * (y - 1994)\right\} + 121 \qquad \textbf{Equation 3}$$

Where as:

Sp_Y^C = Passive savings in county (C) in year (Y) in acre-fee per year (AFY)
H_Y^C = Households in county (C) in year (Y)
Sph_Y^C = Savings per household in county (C) and year (Y)
IU_Y^C = Average indoor use per household in county (C) and year (Y)

For the public-supplied nonresidential sector, passive savings from the Energy Act were calculated based on an estimated 30 percent reduction in nonresidential employee sanitary water use by the year 2030 (North Carolina 2009). Based on pre-1994 plumbing fixture standards, average domestic water use per employee is estimated at 39 gallons per employee per day (ged). Percent savings are interpolated between 0 percent in 1994 to 30 percent in 2030. Savings are then estimated from the decrease in employee sanitary use between 1994 and 2030. Then, savings are multiplied by the

number of employees in the county to determine the total savings. Specifics on how savings are estimated are shown in Equation 4 through Equation 6.

$$\mathrm{Sp}_{\mathrm{Y}}^{\mathrm{C}} = (\mathrm{E}_{\mathrm{Y}}^{\mathrm{C}} \times \mathrm{Spe}_{\mathrm{Y}}^{\mathrm{C}} \times 365) \div 325{,}851 \qquad \textbf{Equation 4}$$

$$\mathrm{Spe}_{\mathrm{Y}}^{\mathrm{C}} = \mathrm{DU}_{\mathrm{Y}}^{\mathrm{C}} - \mathrm{DU}_{\mathrm{Y2007}}^{\mathrm{C}} \qquad \textbf{Equation 5}$$

$$\mathrm{DU}_{\mathrm{Y}}^{\mathrm{C}} = \big((0\% - 30\%) \div (2030 - 1994)\big) * (\mathrm{y} - 1994) + 39 \qquad \textbf{Equation 6}$$

Where as:

Sp_Y^C = Passive savings in county (C) in year (Y) in AFY
E_Y^C = Employment in county (C) in year (Y)
Spe_Y^C = % Savings per employee in county (C) and year (Y)
DU_Y^C = Average domestic use per employee in county (C) and year (Y)

Both monetary and water savings resulting from the Energy Policy Act are increasingly significant as new fixtures replace older, less efficient models. Additionally, replacement with efficient fixtures will reduce the load on wastewater systems and decrease energy demand.

Residential demand reductions from installation of low flow toilets and showerheads lead to significant savings for consumers with very low costs. Installation of a low flow toilet is estimated to save a household of four approximately 60 gallons of water per day, or 22,000 gallons of water per year over a standard 5.0 gpf toilet. Installation of a high efficiency showerhead and faucet aerator will save an average of 7,800 gallons of water per year for the average household. Reductions in shower water also saves energy based on the energy it requires to heat water. Based on a combined water/wastewater price of $4.00/1000 gallons, these small changes can lead to nearly $120 in annual savings per household from water use alone. Additionally, customers can expect decreases in energy bills based on decreases in the amount of energy utilized to heat water. The cost to the customer to install efficient fixtures is low in comparison to the overall benefits. The cost of a toilet replacement ranges from $60-$230/unit dependant on the model and installation. Low flow faucet aerators cost approximately $5-$10, while a low flow showerhead ranges in cost from $8-$50. Given the average lifespan of these fixtures, reduced utility bills generally far out way the costs to the customer.

In addition to monetary savings by the customer, there are also significant savings to water providers based on a decrease in demand. The American Water Works Association (AWWA) reviewed the impacts of implementing national efficiency standards forecasting water production levels from a 1999 baseline. Their results revealed per unit volume of water produced, the cost of savings to utilities was $210 per million gallons (MG) of water saved and $1,000 per MG saved for the community (Dickinson and Maddaus 2001).

Commercial and Residential Metering with Reduction in System Losses

Metering is a fundamental tool of water conservation that benefits both the supplier and the customer. Through a universal metering program, water use is measured on a per unit basis; which requires the installation of individual water meters. When customers are metered and billed for their actual water use, customers can experience a direct consequence of higher overall costs of water. A water bill which varies based on the amount of water used allows customers to realize the actual value of utility-provided water (California 2005). According to U.S. Environmental Protection Agency

(EPA) Water Conservation Plan Guidelines (2004) as well as additional sources, connection metering can lead to a 20 percent reduction in customer end use (Inman and Jeffrey 2006). Metering efforts include the metering of new construction projects, installing meters at existing customer sites, and replacing poorly operating meters (A&N 2005). Analysis of current water conservation activities throughout the state via the CDM conservation matrix, indicates that approximately 74 percent of water utilities meter their customers and approximately 78 percent of the population in Oklahoma is currently metered.

Equations 7 and 8 are used to estimate county-level savings from metering unmetered customers. Savings from metering were applied to public supply residential and nonresidential customers, although the assumed reductions differ for the sectors. Data were collected regarding which water providers are currently metering their customers. Based on the population serviced by the providers, the percent was calculated for the population serviced that is not metered for each county.

$$\mathrm{Sm}_{\mathrm{Y}}^{\mathrm{C}} = \mathrm{Rm} \times \mathrm{M\&I}_{\mathrm{Y}}^{\mathrm{C}} \times \left(\%\mathrm{Um}^{\mathrm{C}} - \%\mathrm{Um}^{\mathrm{T}}\right) \qquad \textbf{Equation 7}$$

$$\%\mathrm{Um}^{\mathrm{C}} = \sum_{\mathrm{C}} \mathrm{Ump} \div \sum_{\mathrm{C}} \mathrm{D} \qquad \textbf{Equation 8}$$

Where as:

Sm_Y^C = Savings from metering unmetered customers in county (C) and year (Y)
$M\&I_Y^C$ = M&I baseline demand in county (C) and year (Y)
$\%Um^C$ = Percent of population unmetered in county (C)
$\%Um^T$= Target percent of population unmetered (if current percent unmetered is greater than target percent unmetered)
Rm = Reduction in demand from metering unmetered customers
$\sum_C Ump$ = Sum of population served unmetered in county (C)
$\sum_C D$ = Sum of population served in county (C) where metering status is known

Program costs to the customer to install meters at single-family residence may be incurred in new construction; however, costs to retrofit water meters at homes are generally paid by the water supplier. Water supplier program costs may include staff time to develop meter programs, meter and installations costs, administration, contractors, and marketing. Costs may vary from supplier to supplier and are reported to range from $250 to $750 per meter for purchase and installation (Bishop and Weber 1995). The Denver Water Department concluded that the average cost per installed meter was $425, including purchase, installation, repair of deteriorating lines, and public education (Denver 1993). Costs for new construction may be lower ($175) and are often passed on to the customer (A&N 2005). Costs for installing retrofits depend on the size of the meter and range from $500-$1000 for single family dwellings and $500-$3000 for multifamily dwellings and commercial connections (A&N 2005).

Metering customers and leak detection are conservation activities that are closely related, because water loss auditing can be more adequately conducted once a utility customer base is fully metered. Water losses occur in two distinctly different manners. Apparent losses occur due to customer meter inaccuracies, billing system data errors and unauthorized consumption. These losses cost utilities revenue and distort data on customer consumption patterns. Losses also occur as real losses or water that escapes the water distribution system, including leakage and storage overflows. These

losses inflate the water utility's production costs and stress water resources since they represent water that is extracted and treated, yet never reaches beneficial use. Non-revenue water (NRW) represents the difference between water production and revenue-generating (billed) consumption. This difference includes authorized unmetered use, apparent losses and real losses.

Analysis of current water conservation efforts in Oklahoma indicates that approximately 70 percent of water utilities have some type of leak detection program. Additionally, Oklahoma water providers are reporting NRW losses at 5-15 percent, with a statewide average at 14 percent.

For OCWP conservation analysis, reduction in real losses at the county-level is assumed. Analysis of real loss reduction mirrors the recommendations for the OCWP provided by the Oklahoma Academy for State Goals Town Hall Report (Town Hall Report) which mentions "setting maximum loss levels".

For leak detection and loss reduction, the weighted average county NRW percent calculated for the baseline forecast is reduced to a target percentage for all counties. If the weighted average is less than or equal to the target percentage, then the NRW will remain equal to the baseline. New NRW volume was calculated based on the reduced percent resulting in water savings using Equation 9.

$$\mathrm{Sl}_{\mathrm{Y}}^{\mathrm{C}} = \mathrm{M\&}I_{\mathrm{Y}}^{\mathrm{C}} - \left\{\left[\mathrm{M\&}I_{\mathrm{Y}}^{\mathrm{C}} \times \left(1 - \mathrm{NRW}_{\mathrm{B}}^{\mathrm{C}}\right) \times \left(\frac{\mathrm{NRW}_{\mathrm{R}}^{\mathrm{C}}}{1 - \mathrm{NRW}_{\mathrm{R}}^{\mathrm{C}}}\right)\right] + \left[\mathrm{M\&}I_{\mathrm{Y}}^{\mathrm{C}} \times \left(1 - \mathrm{NRW}_{\mathrm{B}}^{\mathrm{C}}\right)\right]\right\}$$

Equation 9

Where as:

Sl_Y^C = Savings from leak reduction (reducing system losses) in county (C) and year (Y)
$M\&I_Y^C$ = M&I baseline demand in county (C) and year (Y), includes NRW volume
NRW_B^C = Baseline (B) NWR percent for county (C)
NRW_R^C = Reduced (R) NWR percent for county (C)

Water saved from leakage recovery acts as a new supply and is often the best source for new water resources for systems facing water shortages. Adequate leak detection efforts can lead to a substantial amount of water savings. For example, a one-inch crack in a distribution main at 100 pounds per square inch can leak 57 gpm. Leak detection efforts increase the level of service provided to customers by improving the reliability of water supplies, improving public health protection, and reducing the liability of water suppliers.

A comprehensive nationwide review of water loss reduction programs revealed that the average cost to utilities of leak detection programs was $420 per acre foot saved. The analysis showed that the program costs vary from utility to utility, ranging from $318-$658 per acre foot saved (Sturm and Thornton). One study found that leak detection measures cost an average of $150-$500 per mile of pipeline surveyed (California 2005). A general guideline is that distribution side conservation programs are cheaper when the volume of real losses is high. The lower the volume of real losses, the more effort required to reduce them. In the same study, average avoided retail costs were reported as $1,030 per acre foot (Sturm and Thornton).

Conservation Water Rates

An increasing tiered rate structure, or conservation pricing, is an advanced pricing method used to allocate costs by the quantity of water used. The concept is meant to compel customers to implement water conservation strategies in order to reduce water use and, as a result, reduce their overall cost of water. The most effective rate structure is one in which the cost per unit of water increases as the customer uses more water. This helps water providers to achieve an overall goal of reduced daily peak and seasonal peak usage and overall reduced system demand. According to the USEPA Conservation Plan Guidelines (2004), an increasing block-rate structure can lead to a 5 percent overall reduction in end use. Analysis of current water conservation activities indicates that less than 20 percent of Oklahoma water providers implement conservation pricing. Analysis of such a program is congruent with the Town Hall Report, which indicates the need for appropriately structured, market-based pricing to encourage less water usage.

Close examination of the conservation matrix revealed apparent trends in conservation pricing. Chi-squared was applied to test for the dependence between utility size and conservation pricing. The dataset utilized in this test was comprised of 773 water utilities with known pricing structures and an estimated number of households serviced (households serviced is population serviced in 2007 divided by 2.5 persons per household). Chi-squared analysis concluded that the likelihood of implementing conservation pricing is dependent upon utility size. Water utilities servicing 400 households or less are less likely to implement conservation pricing. The results of this test were used in the development of water conservation scenarios, as discussed in the Conservation Scenarios section of this addendum.

Savings from baseline demand from implementing conservation rates are applied to the target population currently not experiencing a conservation pricing structure within a given county, as shown in Equation 10. The percent of population associated with non-conservation pricing structures was estimated from data collected in the conservation matrix and using Equation 11. Implementing conservation pricing is assumed to reduce residential demand by 5 percent (USEPA 2004). Conservation rates are assumed to apply to the PSR customer base. Conservation rate pricing could also have an effect on commercial and industrial customers, however, recent studies have found savings in this sector to be more variable (California 2005). Given the lack of research on the effects of conservation pricing on the non-residential sector, conservation rate savings will only be applied to the PSR sector in this study.

$$\mathrm{Sr}_{\mathrm{Y}}^{\mathrm{C}} = \mathrm{Rr} \times \mathrm{PSR}_{\mathrm{Y}}^{\mathrm{C}} \times \left(\%\mathrm{Ur}^{\mathrm{C}} - \%\mathrm{Ur}^{\mathrm{T}}\right) \qquad \textbf{Equation 10}$$

$$\%\mathrm{Ur}^{\mathrm{C}} = \sum_{\mathrm{C}} \mathrm{Urp} \div \sum_{\mathrm{C}} \mathrm{D} \qquad \textbf{Equation 11}$$

Where as:

Sr_Y^C = Savings from implementing conservation rate structures in county (C) and year (Y)

PSR_Y^C = PSR baseline demand in county (C) and year (Y)

$\%Ur^C$ = Percent of population served not in conservation rate structure in county (C)

$\%Ur^T$= Target percent of population served not in conservation rate structure (if current percent is greater than target percent)

Rr = Reduction in demand from implementing conservation rate structure

$\sum_C Urp$ = Sum of population served not in conservation rate structure in county (C)

$\sum_C D$ = Sum of population served in county (C) where conservation rate structure status is known

The savings associated with conservation rates are based on customers' responses to increased utility bills. One study reviewing 30 different utilities found the average range of water savings per participant ranged from 55,2188 gallons to negative 6,394 gallons (a increase in water use) with the average participant saving 14,355 gallons, a saving of 4.8 percent (Little and Gallup). Costs to the customers ranged from negative -$22 to $6 per AF saved, with an average cost of negative $3 per AF saved (Little and Gallup). Average cost to the utilities was also low at $0.82 per connection (Little and Gallup). The primary cost associated with implementing rate structures (not including metering) is dedication of staff to design and implement proper rate structures consistent with utility objectives.

Community Education and Information

Customer education is a critical component of any water conservation program and nearly all water conservation efforts are dependent on public awareness and an understanding of the need for conservation (Butler and Howarth 2004). In addition to communicating water savings habits, the effectiveness of additional conservation measures is enhanced by educational programs. While educational savings are difficult to estimate, providing information which changes water use habits can produce considerable water savings. EPA Conservation Plan Guidelines (2004) and additional sources estimate a 3-5 percent reduction in end use as a result of information and education programs (Inman and Jeffrey 2006)

Education programs can be aimed at any age level and often times can be implemented into school curriculums. The City of Norman, for example, is leading the way with a program in which thousands of flyers and bookmarks with water conservation tips are sent home with students several times a year. Community-wide education can focus on a variety of topics including tips for indoor and outdoor water conservation, water-wise landscaping, and general water education. This information can be distributed by means of water bill inserts, brochures, media campaigns, websites, and public exhibitions. According to data collection efforts, 34 percent of water utilities in Oklahoma implement some form of water conservation educational programs.

Savings from implementing an educational program are applied to the percent of baseline demand currently not targeted by a provider-implemented water conservation education program within a given county, as shown in Equation 12. The percent of population not targeted by a water conservation educational program was estimated from data collected in the conservation matrix and using Equation 13. Targeting a population with a water conservation educational program is assumed to reduce PSR, PSNR, and SSR sector demand by 3-5 percent, depending on the program and the sector.

$$\mathrm{Se}_{\mathrm{Y}}^{\mathrm{C}} = \mathrm{M\&}I_{\mathrm{Y}}^{\mathrm{C}} - \left(\%\mathrm{Ue}^{\mathrm{C}} \times \mathrm{Re} \times \mathrm{M\&}I_{\mathrm{Y}}^{\mathrm{C}}\right) \qquad \textbf{Equation 12}$$

$$\%\mathrm{Ue}^{\mathrm{C}} = \sum_{\mathrm{C}} \mathrm{Uep} \div \sum_{\mathrm{C}} \mathrm{D} \qquad \textbf{Equation 13}$$

Where as:

Se_Y^C = Savings from implementing conservation education program in county (C) and year (Y) in AFY

$M\&I_Y^C$ = M&I baseline demand in county (C) and year (Y)

$\%Ue^C$ = Percent of population not targeted by conservation education program in county (C)
Re = Reduction in demand from implementing conservation education program
$\sum_C Uep$ = Sum of population not targeted by conservation education program in county (C)
$\sum_C D$ = Sum of population in county (C) where conservation education program status is known

The cost of an education program will depend on the scale and methods used to reach the targeted population. Both of these factors relate back to utility specific goals and objectives of the program. Free educational curriculum and materials on conservation are readily available but staff time is needed to establish objectives, a target audience, and an appropriate approach and method of outreach. For a basic print media and bill stuffer campaign an annual budget of $10,000 should be sufficient for a small agency with fewer than 5,000 hook ups, for a larger agency with connections around 25,000 an annual budget should be around $50,000 (Colorado WaterWise 2010). A mixed media approach with billboards, web, and radio spots require a larger budget. Television is the most expensive media outlet and is usually only employed by large utility providers. In one review of Portland metropolitan area water suppliers, education programs cost $123 per AF saved ($364 per MG) (RWCP 2004). In another study by the American Water Works Association, youth education programs cost 5 to 57 cents per household per year with an average cost of 24 cents per household (Mirvis and Clark 1998).

Implementation of a High Efficiency Indoor Water Use Ordinance

Mandating minimum plumbing and building code requirements can be a key avenue to advancing water efficiency in indoor plumbing fixtures statewide. Such requirements can apply to indoor water using fixtures and equipment including toilets, urinals, showerheads and faucets, clothes washers and dishwashers. Table 1 shows the allowed water use rates under the Energy Policy Act for commonly used plumbing fixtures. Water use rates from high efficiency (HE) fixtures currently on the market are also shown.

Table 1: Plumbing Fixture Water Use Rates

Fixture	Maximum Flow Rate Mandated by Energy Policy Act (1992)	Maximum Flow Rate Available
Toilet	1.6 gpf*	1.0-1.28 gpf
Urinal	1.0 gpf	0.5 gpf
Faucet	2.5 gpm**	1.0-2.2 gpm
Showerhead	2.5 gpm	2.0 gpm

*gallons per flush (gpf)
**gallons per minute (gpm)

California, Georgia, and Texas have adopted statewide high efficiency (HE) plumbing fixture programs. Additionally, many counties and cities throughout the U.S. have adopted similar programs. While implementing and enforcing new plumbing requirements can be a laborious task for cities, counties, and states, significant water savings are already being accomplished by those implementing these standards. For example, toilets are by far the main source of water use in the average home, accounting for nearly 30 percent of indoor water consumption. Replacement of older, inefficient toilets can save consumers nearly 11 gallons per toilet every day (EPA 2010). As a local

example, if all homes in Oklahoma County have a 1.28 rather than a 1.6 gpf toilet in 2060, savings for that county alone could reach an estimated 1,350 acre-feet.[1]

For the purpose of the OCWP, CDM estimated water savings from the implementation of a statewide ordinance of new indoor water use efficiency standards. The assumption behind such an ordinance is the requirement of high efficiency fixtures in all new construction and in alterations of existing buildings, thus less efficient plumbing fixtures would become phased out in future years. Implementation of an ordinance may take several years, therefore, savings are estimated based on a 2015 implementation date.

Residential water use savings are estimated with Equations 14 through 16, similar to the passive conservation methodology. Based on Table 1, indoor residential water use will, on average, decrease by 10 gallons per household per day through combined savings from implementation of a high efficiency water use ordinance. The program is assumed to reduce indoor residential fixture water use starting in 2015 and achieve 10 gallon per household per day reduction in 2045 (savings are in addition to passive conservation savings). Interpolated savings are multiplied by the number of households in a county to arrive at total savings.

$$\mathrm{Sh}_{\mathrm{Y}}^{\mathrm{C}} = (\mathrm{H}_{\mathrm{Y}}^{\mathrm{C}} \times \mathrm{Sph}_{\mathrm{Y}}^{\mathrm{C}} \times 365) \div 325{,}851 \qquad \textbf{Equation 14}$$

$$\mathrm{Sph}_{\mathrm{Y}}^{\mathrm{C}} = \mathrm{IUh}_{\mathrm{Y}}^{\mathrm{C}} - \mathrm{IUh}_{\mathrm{Y}2015}^{\mathrm{C}} \qquad \textbf{Equation 15}$$

$$\mathrm{IU}_{\mathrm{Y}}^{\mathrm{C}} = \big((1-10) \div (2045-2015)\big) * (\mathrm{y}-2015) \qquad \textbf{Equation 16}$$

Where as:

$\mathrm{Sh}_{\mathrm{Y}}^{\mathrm{C}}$ = Savings from HE plumbing code in county (C) in year (Y) in AFY
$\mathrm{H}_{\mathrm{Y}}^{\mathrm{C}}$ = Households in county (C) in year (Y)
$\mathrm{Sph}_{\mathrm{Y}}^{\mathrm{C}}$ = Savings per household in county (C) and year (Y)
$\mathrm{IU}_{\mathrm{Y}}^{\mathrm{C}}$ = Average indoor savings per household in county (C) and year (Y)

Savings from high efficiency (HE) plumbing codes will also impact the nonresidential sector and are estimated using Equation 17 through 19. According to 2008 Watersmart Guidelines, installation of high efficiency model plumbing fixtures in businesses can improve domestic water use efficiency by 20 percent (East Bay 2008). Based on this figure, domestic use water savings per employee are interpolated from 0 to 20 percent from 2015 to 2045. These 20 percent savings result in a five gallon per employee per day water reduction (in addition to passive savings) by 2045. Per employee water savings are then multiplied by the number of employees per county to determine county-wide nonresidential water savings.

$$\mathrm{Sh}_{\mathrm{Y}}^{\mathrm{C}} = (\mathrm{E}_{\mathrm{Y}}^{\mathrm{C}} \times \mathrm{Spe}_{\mathrm{Y}}^{\mathrm{C}} \times 365) \div 325{,}851 \qquad \textbf{Equation 17}$$

$$\mathrm{Spe}_{\mathrm{Y}}^{\mathrm{C}} = \mathrm{Wpe}_{\mathrm{Y}}^{\mathrm{C}} \times \%\mathrm{Spe}_{\mathrm{Y}}^{\mathrm{C}} \qquad \textbf{Equation 18}$$

$$\%\mathrm{Spe}_{\mathrm{Y}}^{\mathrm{C}} = \big((0\% - 20\%) \div (2045-2015)\big) * (\mathrm{y}-2015) \qquad \textbf{Equation 19}$$

[1] Assumptions: 2060 households estimated at 373,390; 2 toilets per household; 5 flushes per toilet per day.

Where as:

Sh_Y^C = Savings from HE plumbing code in county (C) and year (Y) in AFY

E_Y^C = Employment in county (C) and year (Y)

$\%Spe_Y^C$ = % Savings per employee in county (C) and year (Y)

Spe_Y^C = Savings per employee in county (C) and year (Y) in gallons

Wpe_Y^C = Average domestic water use per employee in county (C) and year (Y)

2.2.2 Conservation Scenarios

The five conservation activities described above are combined in a logical and consistent manner to develop two conservation scenarios for Oklahoma. Using these scenarios, the potential reduction in demand is estimated at the county level. Scenarios were constructed with input from OWRB members and the Utility Superintendant for Water and Wastewater at Edmond Public Utilities. Scenario I, ***Moderately Expanded Conservation***, is an analysis of passive savings combined with expanded metering, leak detection, conservation pricing, and education programs. Scenario II, ***Substantially Expanded Conservation***, is an analysis of more aggressive levels of the Scenario I programs with the addition of the high efficiency ordinance. Both scenarios are described in detail, as follows, and results are provided. Estimated water demands by county resulting from each of these scenarios can be viewed in Appendix B at the end of this report.

Scenario I: Moderately Expanded Conservation

The moderately expanded conservation scenario, or Scenario I, is a combination of conservation programs which are most likely to be implemented by water purveyors in Oklahoma based on costs and ease of implementation. In this scenario, savings are included from passive conservation. Additionally, savings from metering are calculated based on a minimum metering implementation percentage of 90 percent of providers in each county. Counties with metering implementation percentage currently at or above 90 percent were not changed and no future potential savings from metering are calculated for those counties.

Also in Scenario I, leak detection methods are assumed to decrease NRW in each county to 12 percent. Those counties with NRW currently at or below 12 percent were left unchanged and no future potential NRW savings are assumed.

Savings for conservation rates were based on urban and rural populations in each county. As described in the conservation activities portion of this document, implementation of conservation pricing is dependent on the population served by utilities. Analysis of this data shows that high population areas are more likely to implement conservation pricing. Data were collected from the United States Department of Agriculture's Economic Research Service (USDA-ERS) in order to classify Oklahoma counties as high population, urbanizing population, and rural population areas (USDA-ERS). For Scenario I, counties with high population metropolitan areas are assumed to have the highest potential conservation pricing implementation percentage at 60 percent. Counties without metropolitan areas, but with urban populations greater than 2,500 are assumed to implement conservation pricing to 40 percent of its public water supply customers. Rural counties are assumed to implement conservation pricing to only 20 percent of its public water supply customers.

Educational programs under this scenario are assumed to be expanded to educational water bill inserts and a website with water conservation tips. These measures are assumed to decrease water demand by an average of 3 percent for customers not currently targeted by these educational materials (Baumann et. al 1998).

In summary, Scenario I is based on the following assumptions:

- Passive conservation will be achieved by 2026 for PSR, 2030 for PSNR
- 90 percent of water providers in each county will metering their customers, unless current metered percentage is greater than 90 percent
- NRW will be reduced to 12 percent, where applicable
- Conservation pricing will be implemented by 20 percent of purveyors in rural counties, 40 percent in mostly urban counties, and 60 percent in counties with high metropolitan populations
- Educational programs will be implemented by all providers, which includes billing inserts and conservation tip websites to reduce demands by 3 percent

Scenario II: Substantially Expanded Conservation

The substantially expanded conservation scenario involves a set of robust yet achievable conservation programs for Oklahoma water purveyors.

In this scenario, potential savings are included from both passive conservation and implementation of a high efficiency plumbing code ordinance. Savings from metering are calculated for 100 percent statewide implementation.

Additionally, leak detection techniques are expected to decrease NRW to 10 percent in those counties with NRW currently above this threshold. Conservation rates were assumed to be implemented by 100 percent of all counties with high population metropolitan areas, 80 percent implementation in urban counties, and 60 percent in rural counties.

Educational programs in this scenario are expected to reduce demands by 5 percent in counties not currently utilizing water conservation educational programs. This aggressive decrease in water demands is expected based on implementation of mass media campaigns and educational programs encouraging water conservation in addition to the water bill inserts and website with conservation tips encouraged in Scenario I (Inman and Jeffrey 2006).

In summary, Scenario II is based on the following assumptions:

- Passive conservation
- Implementation of metering by all purveyors statewide
- NRW reduction to 10 percent where applicable

- Conservation rate implementation by 60 percent of purveyors in rural counties, 80 percent in mostly urban counties, and 100 percent in counties with high metro populations

- Water conservation education programs include school educational programs and media campaigns in addition to billing inserts and a conservation tip website to reduce demands by 5 percent

- Implementation of a high efficiency plumbing code ordinance

Results

Estimates were developed for county water demand M&I and self supply residential savings for each of the above scenarios. New demands were calculated for 2020-2060 in ten-year increments by calculating the total savings for each program and subtracting the savings from corresponding baseline demands. Table 2 provides the statewide M&I with self supply residential demand forecast summary for the baseline demands as well as estimated demands for Scenario 1 and Scenario 2. The moderately expanded conservation scenario is predicted to decrease statewide residential and non-residential demand by 18 percent by the year 2060, while the substantially expanded scenario is predicted to decrease demand by 27percent by 2060.

Table 2: Statewide Water Demands with Savings from Conservation Scenarios (AFY)

	2020	2030	2040	2050	2060
Baseline	679,648	717,161	750,844	782,137	813,928
Scenario I	585,746	588,269	615,650	641,026	666,806
Scenario II	547,251	538,908	554,837	571,788	594,646
Change from Baseline (AFY)					
Scenario I	93,902	128,891	135,194	141,111	147,122
Scenario II	132,397	178,253	196,007	210,348	219,283

As shown, for 2030 the range of impacts is estimated to be 128,891 AFY and 178,253 AFY for moderately expanded and substantially expanded conservation, respectively. The range of impacts for 2060 is estimated to be 147,122 AFY and 219,283 AFY for moderately expanded and substantially expanded conservation, respectively.

Figure 1 illustrates the estimated savings for the years 2030 and 2060 statewide by program for Scenario I and Scenario II. Savings from Scenario I are estimated to reach nearly 150,000 AFY of water by 2060. In Scenario II, more aggressive programs and the addition of a high efficiency ordinance brings estimated water savings to nearly 220,000 AFY by 2060.

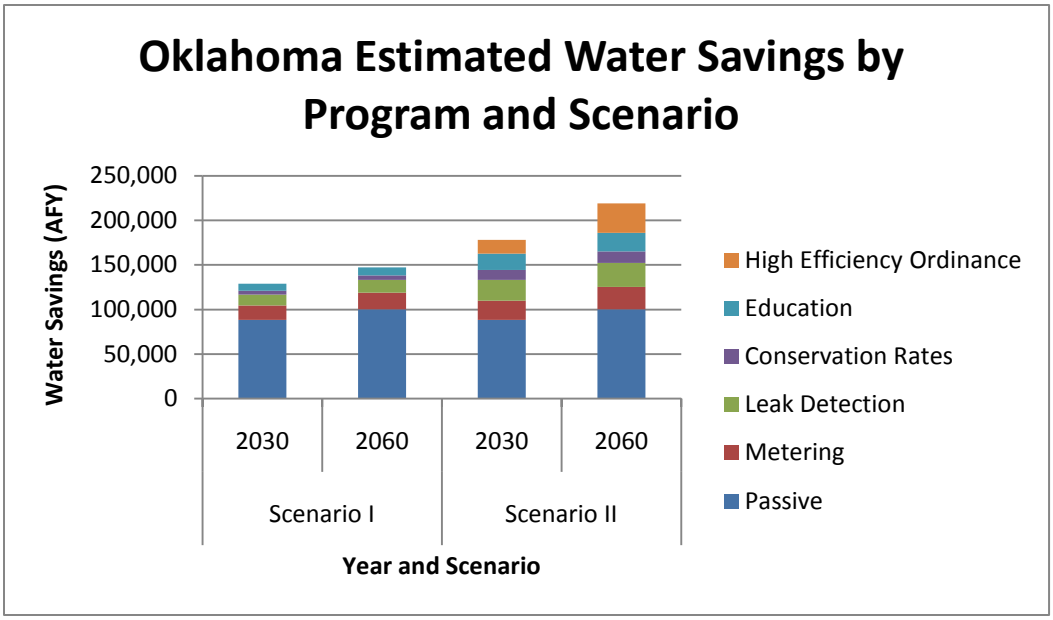


Figure 1: Oklahoma Estimated Water Savings by Program and Scenario

Figure 2 illustrates the estimated decrease in statewide M&I and self supply residential demand by sector in 2060 with implementation of moderately expanded conservation or substantially expanded conservation.

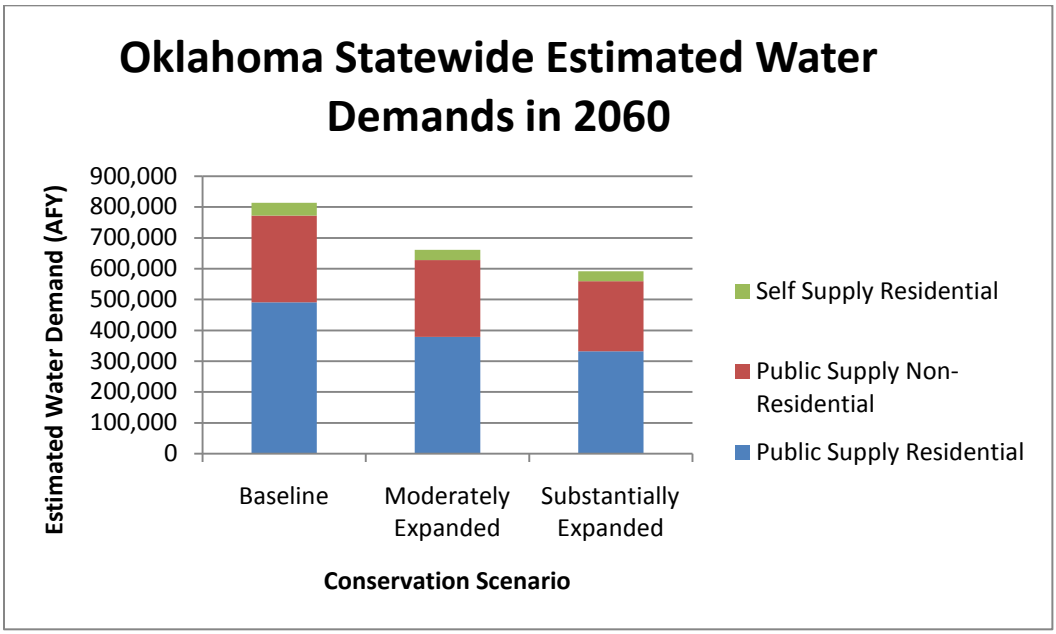


Figure 2: Oklahoma Statewide Estimated Water Demands under Conservation Scenarios in 2060

Cost-Benefit Analysis

The immediate benefits to utilities from reducing water demand derive from the inputs associated with forgoing production of a unit of water. The major inputs include: electricity, chemicals, labor, and water analysis. These inputs or costs are here on referred to as *direct operational costs*. In order to determine the benefits of reductions in water demands, a review of water treatment plant production

and of municipal budgets in Oklahoma was completed. The results of this data review suggest that the cost of delivering a MG of treated groundwater range from $157 - $550 per MG, and for surface water sources from $330 – $1,100 per MG. (Groundwater sources typically cost less to produce compared to surface water sources which require more extensive treatment.) Analysis of water budgets and water production from Stillwater, Ardmore, and Edmond suggested the average direct operational production cost of $354 per MG for groundwater sources and $696 per MG for surface water sources. Water production and the associated cost for each utility mentioned above can be seen in Table 3.

Table 3: Water Production Costs

City Utility and Source	Direct Operational Costs ($)	Production (MG)	Direct Operational Cost per Unit Production ($/MG)
Ardmore Surface Water	$878,565	2,659	$330
Ardmore Groundwater	$41,398	263	$157
Stillwater Surface Water*	$1,406,228	2,135	$659
Edmond Surface Water	$2,235,563	2,032	$1,100
Edmond Groundwater	$881,419	1,603	$550

*Note Stillwater's water production is from surface water sources only.

Analysis of residential and non-residential public supplied water demands in 2060 under Scenario I resulted in statewide savings of 139,935 AF of water. Under Scenario II public supplied statewide savings of 209,396 AF were realized. Additionally, 2005 USGS Water Use Data indicates that 82 percent of withdrawals in Oklahoma are from surface water sources. Based on this assumption, under Scenario I 114,746 AF of the statewide savings are derived from surface water and 25,188 AF from ground water sources. For Scenario II the amount of water saved from surface and groundwater sources would be 171,705 AF and 37,691 AF respectively. Utility savings from conservation can be determined by multiplying the direct operational cost by the amount of water saved from each scenario. Under Scenario I, statewide savings associated with reducing water production in the public-supplied M&I subsector is roughly $26.0 million dollars for surface water sources and $2.9 million dollars for groundwater. Under Scenario II the statewide savings for reducing surface water production increases to $39.0 million dollars and for groundwater the savings increase to $4.3 million dollars.

The conservation programs mentioned under Scenarios I and II reduce the overall water production by water utilities, but not all of the programs reduce the volume of water treated by wastewater treatment (WWT) plants. Supply side conservation programs reduce actual water losses in the

distribution system but do not reduce the amount of wastewater generated. Non-revenue water escapes the distribution system never reaching WWT plants; therefore savings associated with leak detection do not impact wastewater flows. However, demand side conservation programs that modify water use behavior can reduce the amount of treated wastewater. These programs include metering, conservation rates, education, high efficiency plumbing codes, and passive conservation.

To determine the reductions of wastewater treated by WWT plants, only the public-supplied residential subsector water use was considered. While demand reductions in the public-supplied non-residential subsector would also have a direct effect on wastewater, not enough information is available to determine the amount of wastewater produced by this subsector. For planning purposes, it is assumed that all self-supplied residential wastewater is treated by private septic systems, while public-supplied residences have local sewer services, and that all non-consumptive public-supplied water use is dispensed through municipal sewer systems. In public-supplied residences, all water saved from high efficiency plumbing codes and passive conservation is associated with indoor use and is assumed to reduce or abate wastewater treatment. Therefore, these two programs are assumed to have a 100 percent wastewater impact factor. Other behavioral/supply conservation programs like education, metering, and conservation rates reduce indoor and outdoor water use. Consequently, not all the water saved from these programs can be linked to reductions in wastewater treatment. CDM assumes 25 percent of the water associated with these three programs is indoor use and therefore a wastewater saving impact factor of 25 percent is assigned for these programs.

Analysis of water savings attributable to these five programs in 2060 resulted in a total saving of 103,223 AFY under Scenario I and 141,218 AFY under Scenario II for the public-supplied residential subsector. By multiplying the savings associated with each of the five conservation programs with their respective impact factors and summing the products, the total reduction of treated waste water could be determined. The reduction of treated wastewater was 83,377 AFY (27,180 MG) for Scenario I and 107,567 AFY (107,567 MG) for Scenario II. As with water production facilities, the cost directly related to treating a quantity of wastewater is coupled with the four direct operational costs. A review of the three previously mentioned municipal budgets and corresponding WWT plants suggests the per unit cost of treating one MG of wastewater is $358-$975. The average per unit cost of wastewater treatment in these three cities was $681 per MG of wastewater and was assumed to be the average unit cost of wastewater treatment throughout Oklahoma. By multiplying the per unit cost of wastewater treatment with the estimated reduction of wastewater, the result is the wastewater savings associated with the conservation programs. Scenario I had reduced wastewater flows of 27,180 MG of water resulting in monetary savings of nearly $18.5 million ($681 per MG * 27,180MG = $18,509,824). Under Scenario II, wastewater savings of 35,051 MG results in a monetary saving of about $23.9 million ($681 per MG*35,051 MG = $23,869,429) to the water utilities. A summary of statewide savings related to water production and wastewater treatment can be seen in Table 4.

Table 4: Statewide Water Conservation Savings from Reduced Water Production and Wastewater Treatment in 2060

	Surface Water	Groundwater	Wastewater	Total
Scenario I	$26,036,731	$2,903,100	$18,510,151	$47,449,981
Scenario II	$38,961,078	$4,344,167	$23,880,443	$67,185,689

Another significant benefit of water conservation is the reduction of energy needed to produce water. Water and energy resources are highly collaborated and form a water-energy nexus. The basic concept of the water-energy nexus is that it takes water to produce energy and energy is used in the distribution and treatment of water. A reduction in water demand reduces the energy needed to provide water and reductions in energy demand reduce the need for water use (withdrawal and consumption) in power production facilities.

Approximately four percent of all energy consumption in the United States is used for water distribution and treatment (EPRI 2002). Energy is required to pump water from its source, to a treatment plant, to a customer, and finally to a wastewater facility. Eighty-five percent of the energy involved in the initial treatment and distribution of water is for pumping requirements (Hamilton et. al 2009). It takes anywhere from 540-3,000 kilowatt hours (KWh) to pump a MG of water from its original source and treat it (Arora and Lechevallier 1998; Hamilton et al. 2009; Elliot et al. 2003). Groundwater sources typically require 30 percent more electricity than surface water on a per unit basis due to increased pumping requirements (EPRI 2002). Based on several studies citing national average energy costs, CDM assumes the energy costs of surface water production in Oklahoma to be 1,400 KWh per MG of water, for groundwater 1,800 KWh per MG (Elliot et al. 2003; EPRI 2002; Hamilton et al. 2009). These figures represent the amount of energy imbedded in publicly supplied water. It should be noted that the variation in the energy intensity of water is high and depends on several factors including: the age of distribution system, depth and distance water has to be transported, and quality of water before and after initial treatment.

Using the water savings derived from the two conservation scenarios and the energy intensity of water for each water source, the amount of energy saved for each conservation scenario can be determined. As mentioned previously, 82 percent of public-supplied water in Oklahoma is derived from surface water sources while 18 percent is derived from groundwater sources. Assuming the energy intensity of pumping and distributing surface water and groundwater sources is 1,400 KWh per MG and 1,800 KWh per MG, respectively, the energy saved in conserving 139,935 AF (45,598 MG) of water would be 67,119,686 KWh or 67.12 gigawatt hours (GWh). Similarly, under Scenario II a savings of 209,396 AF (68,232 MG) of water would result in the abatement of 100,437,163,682 KWh or 100.44 GWh of electricity. The calculation to determine the amount of energy saved from reducing water production is shown below in Equation 20.

$$ES_{\text{scy}} = VS_{\text{scy}} \times (sP \times sI + gP \times gI) \quad \textbf{Equation 20}$$

Where:

ES_{scy} =Energy saved associated with reductions in water demand of public supply systems from conservation scenario (sc) in year (y)
VS_{scy} =Volume of water saved from scenario (sc) in year (y)
sP = Percent of water derived from surface water sources in Oklahoma (82%)
sI = Intensity of energy in production of surface water (1,400 KWh per MG)
gP = Percent of water derived from groundwater sources in Oklahoma (18%)
gI= Intensity of energy in production of groundwater (1,800 KWh per MG)

Energy is also saved by reducing the amount of wastewater that needs to be treated. The amount of energy required to recover and treat wastewater range from 955-2,500 KWh per MG depending on

the treatment technique (Hamilton et al. 2009; EPRI 2002). The most common treatment technique is activated sludge with an average energy requirement of 1,300 KWh/MG treated. This energy requirement is assumed to be the energy cost of wastewater treatment in Oklahoma. As previously stated, the amount of wastewater abated from conservation Scenarios I and II is 27,180 MG and 35,051MG respectively. The energy intensity in treating a MG of wastewater is assumed to be 1,300 KWh. Therefore, the amount of electricity saved from abatement of wastewater treatment is 35.33-45.57 GWh of energy depending on the conservation scenario.

The amount of energy saved from conserving water is the sum of energy saved from initial water production and wastewater treatment. For Scenario I, the statewide reduction in energy demands is 102.45 GWh and for Scenario II it is 146.00 GWh.

Water is required throughout the production lifespan of energy. It is used in the extraction of fuel sources in mining, drilling, or in the case of bio-fuels, agricultural operations. Water is also needed in the production of energy in thermoelectric power generation to cool equipment and produce steam. In the U.S., thermoelectric power generation accounts for approximately 40 percent of all freshwater withdrawals (Goldstein 2008). The consumption and withdrawal rates of water depend on numerous factors including the type of heat source, prime mover, and cooling system (Goldstein 2008). In Oklahoma, over 93 percent of electricity produced is derived from thermoelectric plants using natural gas or coal derived products as their primary fuel source (EIA 2010). Based on CDM's analysis of 58 power production plants in Oklahoma and USGS 2005 estimates of water use for thermoelectric power, CDM assumed 775 gallons of water are withdrawn for every megawatt hour of electricity (MWh) produced (OCWP 2011 Update Water Demand Forecast Report October 2009). Consumptive use of water in thermoelectric power plants was assumed to be 480 gallons per MWh (Wolfe, 2008).

As stated previously, the savings derived from the conservation scenarios resulted in Oklahoma water utilities reducing water production and wastewater treatment by 72,766 MG to 103,282 MG in 2060. This results in a reduction in power demand of 102.45-146.00 GWh for both water production and wastewater treatment for Scenario I and II respectively. The water withdrawals and consumptive use required for thermoelectric power generation is assumed to be 775 G per MWh and 480 G per MWh respectively. If 93 percent of all energy production is derived from thermoelectric plants, then the reduction in water withdrawals associated with the decrease in power production range from 71.9 MG for Scenario I and 102.5 MG for Scenario II. The decrease in consumptive use associated with this power reduction is 45.7-65.2 MG. The calculations used to derive consumptive use and water withdraws saved from reduced power production are shown below in Equation 21 and Equation 22.

$$WSW_{\text{scy}} = ES_{\text{scy}} \times wI \times eP \qquad \textbf{Equation 21}$$

$$WSC_{\text{scy}} = ES_{\text{scy}} \times CI \times eP \qquad \textbf{Equation 22}$$

Where:

WSW_{scy} = Volume of water withdrawal saved from reductions in energy demand for scenario (sc) in year(y)

WSC_{scy} = Volume of water consumption saved from reductions in energy demand for scenario (sc) in year(y)
ES_{scy} = Amount of electricity saved from reductions in water demands for scenario (sc) in year (y)
wI = Intensity of water withdrawals for power production (775 G per MWh)
CI = Intensity of water consumption for power production (480 G per MWh)
eP = Percent of energy produced by thermoelectric plants using natural gas and coal (93%)

Table 5 provides a summary of potential water and energy savings from each conservation scenario.

Table 5: Statewide Water and Energy Savings Derived From Conservation Scenarios in 2060

Scenario	Water Saved From Conservation	Energy Saved From Water Conservation	Water Saved From Energy Reductions	
	MG	GWh	Consumptive Use (MG)	Withdrawals (MG)
Scenario I	45,598	102	46	72
Scenario II	68,232	146	65	103

2.3 Agricultural Conservation

In order to provide useful and realistic conservation scenarios, CDM conducted a comprehensive review of current and future potential conservation measures and trends associated with agricultural irrigation in Oklahoma. The conservation scenarios provided herein were developed based on patterns of current conservation and factors affecting future conservation activities including trends in regional irrigation practices, recent improvements of water conveyance systems, ease and cost effectiveness to farmers, and farming economics.

A comprehensive review of available data and academic research was undertaken to inform the development of useful and realistic scenarios of potential agriculture conservation in Oklahoma. Information on current and historic agricultural practices was gathered from the sources listed below. Much of this data was collected and reviewed for development of the OCWP baseline agriculture forecast.

- USDA Farm and Ranch Irrigation Survey (FRIS) for Oklahoma
- USDA Census of Agriculture
- USGS Water Use for Oklahoma
- NRCS Irrigation Handbook

In Oklahoma, agriculture irrigation was the largest source of water withdraws in 2007; accounting for 40.5 percent of all withdrawals. Agricultural water demand is driven by numerous factors including the acreage and type of crop irrigated, irrigation system (i.e., surface, sprinkler, and micro-irrigation), seasonal rainfall, water availability, and fuel and commodity prices. Water savings can be achieved through a number of methods including: implementing more efficient irrigation methods and

improving deficit irrigation techniques, shifting from water intensive to water efficient crops, and shifting to dryland production. These activities have differing economic, environmental, and political impacts and have various likelihoods of implementation, as discussed in the following sections.

2.3.1 Conservation Activities

The following section provides an overview of potential conservation activities performed to save water. A summary of estimated savings from these activities is provided in **Appendix A** at the end of this report.

Dryland Production

Dryland production is the shift from irrigation dependent crops to rainfall dependent crops. Essentially, this reduces irrigation demands to zero and a detailed analysis of water demands under dryland production is not required for the OCWP. Dryland production, however, is a viable future alternative in certain regions and discussion of this alternative is warranted.

The likelihood of dryland production in Oklahoma is dependent upon numerous, interrelated factors and varies by region. This type of farming is shown to have economic impacts that may reduce the level of implementation. Dryland production produces significant decreases in crop yield. In Nebraska, dryland farming of the region's most popular crops had average yields 35 percent less than irrigated crop yields, and this difference would be even greater under drought conditions (Lamphear 2005). In the Southern High Plains of Texas, irrigation provides a 150 percent yield increase over dryland farming (Colaizzi et al. 2004).

It can be assumed that farmers across the State are not likely to shift to dryland production where irrigation systems are currently in place unless faced with severe water shortages, high pumping costs, or implementation of policies that provided incentives to do so. Almas et al. (1998) has shown through an economic optimization model that irrigated acres will significantly decrease in Cimarron, Texas, and Beaver Counties by 2060 due to groundwater declines. Thus, in Panhandle counties, transition from irrigation to dryland farming is a viable (and likely) future outcome.

Irrigation Efficiency

Improvements in irrigation system deliveries reduces on-farm system losses and thus reduces the amount of water applied to the irrigation scheme. There are three main types of irrigation systems, each with unique efficiencies and options for improvement: sprinkler, surface, and micro-irrigation. The field application efficiencies of these systems assumed for the baseline forecast are 85 percent, 64 percent, and 89 percent, respectively. Future conditions of system efficiency vary by type of system, as discussed below.

Sprinkler Irrigation

Sprinkler systems irrigate by spraying pressurized water over the field through above ground piping structures. According to the 2005 USGS Water Use Survey, 81 percent of all irrigated acres in Oklahoma are irrigated by sprinkler systems. There are numerous types of sprinkler systems on the market with varying levels of efficiency. A low pressure center pivot system with drop down nozzles increases efficiency over standard sprinkler systems by reducing evaporation losses. An example of this type of system is the Low Energy Precision Application (LEPA) system. LEPA is a highly efficient

sprinkler system and is reported to have irrigation efficiencies ranging from 85 percent to 95 percent (Lynne and Morris 2006, Sloggett and Dickason, Aillery et al. 2009, Schneider 2000). LEPA can be used on low pressure linear move and center pivot sprinkler irrigation systems and applies water on the soil surface or at crop height (NRCS 2010).

Use of high efficient low pressure sprinkler systems in the West has been expanding (Aillery et al. 2009). A review of the FRIS shows that the percent area of irrigated lands using low pressure sprinkler systems grew by 8 percent from 1998-2003 and by 12 percent from 2003-2008. By 2008, 77 percent of the irrigated lands in Oklahoma were using low pressure sprinkler systems, with the majority being center pivot systems (USDA FRIS 1998, 2003, 2008).

Continued growth of LEPA sprinkler systems is expected. A study of irrigation technology adaption in the Central Plains suggested LEPA systems would grow by 27 percent by 2015 (Aillery and Schaible 2003). Other studies of irrigation technology adaption compared the potential use of six irrigation systems under four groundwater supply scenarios, and concluded that LEPA was the preferred irrigation method in all four scenarios (Feng and Segarra 1994). LEPA operational costs were also found not to be binding and the authors suggested LEPA could feasibly be used on all irrigated acreage within the study region (Feng and Segarra 1994).

Thus, it is reasonable to assume implementation of LEPA for all sprinkler systems, increasing application efficiency to 90 percent. This is a 5 percent increase in sprinkler system field application efficiency from the baseline forecast.

Surface Irrigation

Surface irrigation, also referred to as flood or furrow irrigation, relies on gravity to distribute water across the surface of a field. In Oklahoma, 18 percent of all irrigated acres are irrigated by surface irrigation methods (2005 USGS Water Use Survey). Surface irrigation has the lowest field application efficiency of the three irrigation methods due to seepage losses of the conveyance system and application method. Regions with large areas of surface irrigation tend to have low weighted efficiencies and could have a high potential for agricultural water conservation improvements. However, it should be noted that surface water irrigation has a higher return flow and lower consumptive use ratio when compared to other irrigation methods. Thus, true savings in consumptive demands should be carefully considered. That is, shifting away from surface irrigation may reduce water withdrawals, but will not change the consumptive water requirements of the crop.

Historically in Oklahoma, shifts from surface to sprinkler irrigation systems have occurred but this trend is slowing. According to the USGS Water Use Survey data from 1995-2000, 10 percent of the irrigated acres in Oklahoma experienced a shift from surface to sprinkler systems. From 2000-2005, this trend slowed to 3.8 percent. Analysis of the FRIS data showed similar findings in the state; with a large initial shift of surface to sprinkler systems followed by a significant decrease in this trend from 2003-2008. A recent reduction in growth of surface to sprinkler systems is a trend observed throughout the western states (Aillery et al. 2009). The implication is that farmers most likely to shift away from surface irrigation may have already done so. Additional transitions away from surface irrigation may require greater incentives.

Water conservation can be achieved in regions with surface irrigation by improving the efficiency of surface systems. There are two regions in Oklahoma where surface irrigation systems are used extensively: the southwest counties Harmon, Jackson, Tillman, and Kiowa, and the southeast counties McCurtain and Leflore.

McCurtain County has only 421 acres of irrigated land, yet all of the irrigated water in McCurtain is delivered by surface irrigation systems (USDA FRIS 1998). Leflore County has 9,398 acres of irrigated land with the majority of the irrigated land used for soybean and spinach production. In Leflore County, 72 percent of irrigated water is applied through surface irrigation systems (USDA FRIS 1998). It is assumed that McCurtain and Leflore counties in the southeast are unlikely to take measures to improve system losses. These counties are in a humid, surface water rich area of the state and there is little incentive for irrigation improvements.

Harmon, Jackson, Tillman, and Kiowa counties have relatively large areas of land using surface irrigation methods. In Jackson County, 88 percent of the 55,120 acres irrigated is irrigated by surface water methods. Most of the surface water is provided by the Lugert-Altus Irrigation District (LAID) (Mull 2002). The LAID is the only large scale irrigation district in the state that primarily uses surface water and open conveyance canals. According to Mull (2002), only 2 percent of the 270 miles of LAID canals are lined or piped resulting in an average delivery efficiency of 65 to 72 percent.

The district has received funding from the Bureau of Reclamation (BOR) and other sources to upgrade its irrigation delivery system by expanding its remote monitoring and automation sites, improving flow measurements, and replacing and rehabilitating farm turnouts. The project is expected to save 8,000-10,000 acre feet (AF) of water per year (Mull 2002, Smith 2005). If an average of 9,000 AF of water saving is realized, then the delivery efficiency for the system would increase to approximately 80 percent.

Improvement in the conveyance efficiency of the LAID, through improvements to delivery infrastructure and installment of tailwater recovery pits, is reflected in surface irrigation efficiency assumptions for Harmon, Jackson, Kiowa and Tillman counties. Thus, for this region, the field application efficiency of surface irrigation is assumed to increase to 80 percent, which is an increase of 16 percent from the baseline forecast.

Micro-Irrigation

Micro-irrigation is a highly efficient form of irrigation using low pressure application of water onto the soil surface near the plant or below the soil surface at the plant root zone. There are different methods and types of micro-irrigation (spray, mist, drip) which have reported application efficiencies ranging from 85 percent to 95 percent (Aillery and Schaible 2006, Lynne and Morris 2006). An analysis of the USDA and USGS surveys shows slow growth of the number of acres irrigated by micro-irrigation from 1995-2008 in Oklahoma. Micro-irrigated acres represent less than 1 percent of total irrigated acres.

Micro-irrigation is used with some vegetables and widely used with perennial crops such as orchards and vineyards (Aillery and Schaible 2006). There have been attempts to expand the use of micro-irrigation using sub-surface drip irrigation (SDI) for field crops with mixed results. Based on the current crop production in Oklahoma, slow system adoption, and unverified feasibility of system use

with most field crops; the expansion of acreage using micro-irrigation methods is expected to be minimal and insignificant, particularly in regions with unreliable water supplies. The southwest area of Oklahoma is the only region where micro-irrigation is expected to expand.

Mr. Tom Buchanan, manager of the LAID, cites that the four counties of southwest Oklahoma will most likely see an increase in micro-irrigation due to the increased use of SDI to irrigate cotton and possibly corn. Cotton is an important regional crop and can be successfully irrigated by SDI systems. SDI has been adopted by commercial cotton growers in Texas since the mid 1980s where it has been documented to slightly outperform LEPA and other spray systems in term of lint yields, lint quality, and water use efficiency (Almas et al. 1999). SDI has also has been applied to corn production but with less success. Studies in western Kansas compared profitability of irrigating corn with SDI to irrigation by center pivot sprinklers. SDI was found to have less net returns on large fields but was found to be more profitable on smaller corn fields ranging from 13-25 hectares (O'Brien et al. 1998). These findings were highly dependent on the price and assumed life span of SDI systems. The use of SDI to irrigate corn is likely to increase when its reliability and longevity is established, the cost of SDI systems and installment decreases, and potential benefits are realized (O'Brien et al. 1998).

Conversion of surface irrigation to SDI is assumed for the four county region of southwest Oklahoma for 10 percent of total irrigated acres. No additional conversion to micro-irrigation will be assumed for the remaining areas of the state.

Crop Shifting

Different crops require varying amounts of irrigation water to supplement the gap between crop consumptive needs and rainfall. Water requirements are based on crop response to water inputs. Corn has a high yield response to water inputs and, compared to other crops, continues to improve yield with additional water (Dumler 2004). Other crops, such as grain sorghum and wheat, have lower yield responses (Dumler 2004). Their yields per unit of irrigation are not as high as corn, particularly at high levels of irrigation; conversely their yields are not as negatively affected by water deficits. Additionally, less water responsive crops need less irrigation to reach their maximum yield potential (Dumler 2004).

Shifting from high water demanding /responsive crops to less water demanding crops reduces the amount of irrigation required per acre. Water intensive crops include alfalfa, pasture grass, and corn for grain. Cotton and peanuts are mid-level water demanding, while wheat, soybeans, and corn silage are less demanding (NRCS 2010, Dumler 2004, Lin and Pfeiffer 2010). Limiting the acreage of high water demanding crops can reduce the amount of water required for irrigation in a given year. With proper management and knowledge, crop shifting can reduce the amount of irrigated water required per acre of crop. Crop shifting has been used as a water conservation tool in other states. In a simulated crop mix in Idaho, 10 percent of the alfalfa and silage corn was shifted into barley with a fallow or potato rotation and resulted in a 7 percent decrease in statewide water consumption (Contor and Pelot 2008).

For crop shifting, it is assumed that all acres of corn for grain, and forage crops including alfalfa and pasture grass shift to grain for sorghum. While is it highly unlikely that all water intensive crop

production will stop, this assumption allows for analysis of full implementation of the "what-if" scenario.

2.3.2 Conservation Scenarios

For analysis of potential agriculture conservation water savings for the OCWP, two conservation scenarios were developed for examining impacts of improved irrigation efficiencies and crop shifting. The scenarios correspond to work completed for the M&I sector. In order to allow adequate time to implement these activities, the scenarios are assumed to be implemented beginning in 2015. However, the actual implementation date may shift to a later or earlier date depending upon factors including budgeting issues, supply and demand, and future weather conditions. County-level results of the conservation scenarios are input into the "Gap Tool" to determine if the levels of conservation are effective in reducing or eliminating modeled water supply gaps. The assumptions for the scenarios are provided below, followed by the resulting statewide savings. Estimated savings by county can be found in Appendix B at the end of this document.

Scenario I: Moderately Expanded Conservation

- The field application efficiency of surface irrigation systems for Harmon, Jackson, Tillman, and Kiowa counties will increase to 80 percent beginning in 2015.
- In Harmon, Jackson, Tillman, and Kiowa counties, 10 percent of the land irrigated by surface irrigation will shift to micro-irrigation beginning in 2015.
- All sprinkler systems will have a field application efficiency of 90 percent beginning in 2015, representing implementation of LEPA nozzles on existing sprinkler systems.
- No improvement in surface irrigation for McCurtain and Leflore counties.
- While water withdrawals will be reduced through irrigation efficiency improvements, the consumptive use fraction of water withdrawals will increase (i.e., consumptive volume is expected to remain the same, explained in more detail in the "Results and Discussion" section in this report).
- Water saved through conservation activities is not applied to a water scheme elsewhere, such as expanding the number of irrigated acres, thus achieving true conservation.

Scenario II: Substantially Expanded Conservation

- All assumptions from Scenario I are applicable.
- All acres of corn for grain and forage crops including alfalfa and pasture grass shift to grain for sorghum beginning in 2015.

Results and Discussion

Statewide results of the agriculture conservation scenario demand analysis are shown in Table 6. Under Scenario I, savings of about 67,600 AFY in 2060, or 7.5 percent are achieved from the baseline scenario. These savings are achieved through improved irrigation efficiency. Under Scenario

II, savings of about 196,500 AFY in 2060, or 22 percent are achieved from the baseline scenario. These savings are achieved through improved irrigation efficiency and shifting to less water intensive crops. The crop shift assumption accounts for savings of about 128,900 AFY in 2060, or about 65 percent of the Scenario II savings. Less extreme assumptions about crop shifting (e.g., half of crops shift) would result in a reduction of the Scenario II savings.

Table 6: Statewide Demand Projections and Water Savings for Agriculture Conservation Scenarios in AFY

	2020	2030	2040	2050	2060
Baseline	775,661	806,112	836,562	859,932	897,464
Scenario I	716,070	744,512	772,953	794,781	829,837
Scenario II	608,146	631,340	654,535	672,335	700,923
Savings from Baseline					
Scenario I	59,591	61,600	63,609	65,151	67,628
Scenario II	167,514	174,771	182,028	187,597	196,541

Figure 3, below illustrates estimated statewide water demands for the agricultural subsector in 2060

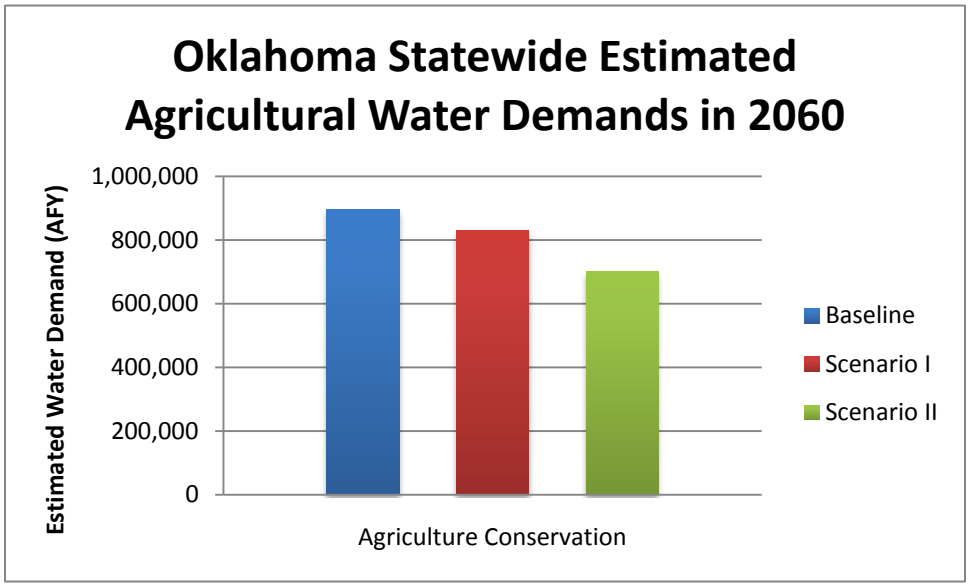


Figure 3. Oklahoma Statewide Estimated Agricultural Water Demands in 2060.

The agri-business sector is a crucial part of the economy in Oklahoma. One analysis concluded that agriculture, agri-business, and agricultural support activities provide over 17 percent of the state's employment, over 343,000 jobs (Battelle 2007). The market value of agricultural goods sold has increased from $1.6 billion in 1974 to $4.2 billion in 2005 (inflation adjusted) (Battelle 2007). Other studies have shown the direct agricultural contribution (agricultural production and processing) to Oklahoma's Gross State Product (GSP) was $3.2 billion in 2000 (Woods 2003). Accounting for indirect and induced contributions increases this to $7.4 billion dollars or 7.6 percent of the GSP (Woods 2003). Irrigated agriculture claims a large percentage of this economic activity statewide, and may claim an even larger percentage in some regions. Given the economic and societal importance of agriculture in Oklahoma, the impacts and drivers of water conservation in the agriculture sector should be considered carefully.

Strong evidence in the literature suggests that increases in irrigation efficiencies through technology adoption or management activities does not always equate to water savings or reduced water use. This can happen when farmers use the water savings to expand irrigated acreage or apply the saved water to an existing irrigation scheme. Farmers with more efficient irrigation systems can increase overall consumptive use by expanding acreage of irrigated crops or increasing irrigation per acre through an increase of yields or by shifting to more water intensive crops (Petterson and Upendram 2007, Goldern and Petterson 2006, Lin and Pfeiffer 2010). In Kansas, federal and state programs have given assistance to farmers to upgrade irrigation technologies in order to reduce withdraws of the Ogallala aquifer (Goldern and Petterson 2006, Lin and Pfeiffer 2010). Compared to standard center pivot systems, systems with high efficient drop nozzles did not reduce groundwater extraction but increased it. A one percent increase in the percentage of acres irrigated with dropped nozzles resulted in a 1.7 percent increase in water extracted per farmed acre (Lin and Pfeiffer 2010). The increase in groundwater extraction was attributed to shifts in cropping patterns to more water intensive crops (Lin and Pfeiffer 2010). In western Kansas, producers were also found to shift from a water efficient crop (sorghum) to a water intensive crop (corn) after a simulated conversion from surface irrigation systems to center pivots (Petterson and Upendram 2007). Others have argued that a similar irrigation conversion leads to increases in irrigated acreage with minimal crop shifting, depending on the type of technology adoption and crop grown (Goldern and Petterson 2006).

Exactly how increased efficiencies can lead to increased water use is debatable. However, reductions in overall consumptive use (including what is required by the crop and that lost to evaporation) is the only sure way water savings at the basin level can be realized. Investments in cost sharing programs to increase adoption of efficient irrigation systems were found to be less effective at reducing consumptive use per dollar invested than a water buyout program, and in certain situations the cost sharing program increased consumptive use (Goldern and Petterson 2006). Care needs to be given when supporting a policy that will increase efficiency and needs to consider whole basin effects. Adoption of efficient irrigation technology does have benefits to the producer and is still an important part of water conservation, but should be implemented with goal-oriented conservation policies that consider net reductions in consumptive use.

Correspondence with Mr. Tom Buchanan at the LAID indicates that reduction in irrigation waste water will most likely result in increased irrigated acres. He believes that irrigation water recovered from reduced seepage or runoff will eventually be used to expand irrigation in the surrounding areas. In general, the region's amount of irrigated cropland is limited by the amount of water available. Given the assumptions outlined in Scenario I, enough water would be conserved in the four-county area of southwest Oklahoma to irrigate approximately 22,000 more acres.[2]

The true water savings associated with irrigation efficiency and crop shifting would likely only be realized given economic incentives. That is, the most likely way to see a change from what is

[2] 22,000 acres is derived using the assumption that water saved through the conservation activities outlined in scenario 1 is applied to additional potential farmland, in order to expand the number of irrigated acres. This number is calculated by taking the amount of saved water from conservation in each county and dividing it by the county specific weighted Crop Irrigation Requirement (Wt CIR), The amount of additional land irrigated for the four counties are summed together to get 22,000 acres.

described above is if some type of economic incentive is in place to both reduce water use within the current irrigation infrastructure and limit growth. These incentives could be from a number of state and federal entities.

The factors that impact adoption of water conservation actions, particularly technology adoption, are complex and site specific. The high initial capital requirements of new irrigation systems often impede farmers from adopting more efficient systems. Even when systems are proven to be economically profitable in the long term, many farmers do not have the financial resources for such an investment, this is particularly true of smaller farming operations (Aillery and Schaible 2006). The cost of water is also an important driver in regards to water conservation. The cost of water to agriculture producers is often low relative to the cost of providing water and the opportunity costs of non-agriculture users. This reduces the incentive to adopt water conservation measures and it has been shown that producers with high water cost are more likely to adopt conservation measures (Aillery and Schaible 2006). The reliability of water supplies also influences adoption of conservation actions. Junior water right holders will often buffer against possible late-season shortages by overwatering during peak-flows, additionally the threat of losing the rights of water saved from potential conservation actions limits the incentive to conserve (Aillery and Schaible 2006). Often water saved by conservation measures is not available for market transfers and so is used to expand irrigation or improve yields. In one survey by the U.S. Department of Commerce the potential loss of water rights was found to be a critical concern to 20 percent of irrigators when considering water conservation (Aillery and Schaible 2006). Water right policies can also impede development of an operational water market which could otherwise compensate farmers for unused or saved water.

2.4 Summary of Statewide Conservation

In an effort to assess the impacts of public supply and self supply residential, public supply non-residential, and agriculture conservation statewide, CDM combined conservation scenarios to provide statewide water conservation savings. Scenario I from the M&I sector, agricultural sector, and thermoelectric withdrawals were combined to produce statewide estimates for a moderately expanded conservation scenario. Additionally, Scenario II from the M&I sectors, agricultural sector, and thermoelectric withdrawals were combined to produce estimates of a statewide substantially expanded conservation scenario. **Table 7** provides a summary of demand projections and water savings resulting from these conservation scenarios. In 2030, the range of impact is 184,400 to 345,400, or 12.4 percent to 23.2 percent decrease in statewide water demands. In 2060, the range of impact is 207,500 to 405,938 or 12.4 percent to 32.1 percent decrease. **Figure 4** provides an illustration of the variation in statewide demands in 2060 with baseline, scenario I and scenario II demands. **Figure 5** illustrates statewide savings for scenario I and scenario II in 2030 and 2060.

Table 7: M&I and Agriculture Combined Statewide Demand Projections and Water Savings for Conservation Scenarios in AFY

	2020	2030	2040	2050	2060
Baseline	1,455,309	1,523,273	1,587,406	1,642,069	1,711,392
Scenario I	1,301,816	1,332,781	1,388,603	1,435,807	1,496,643
Scenario II	1,155,397	1,170,248	1,209,372	1,244,123	1,295,569
Savings from Baseline					
Scenario I	153,493	190,492	198,803	206,262	214,749
Scenario II	299,912	353,025	378,034	397,946	415,823

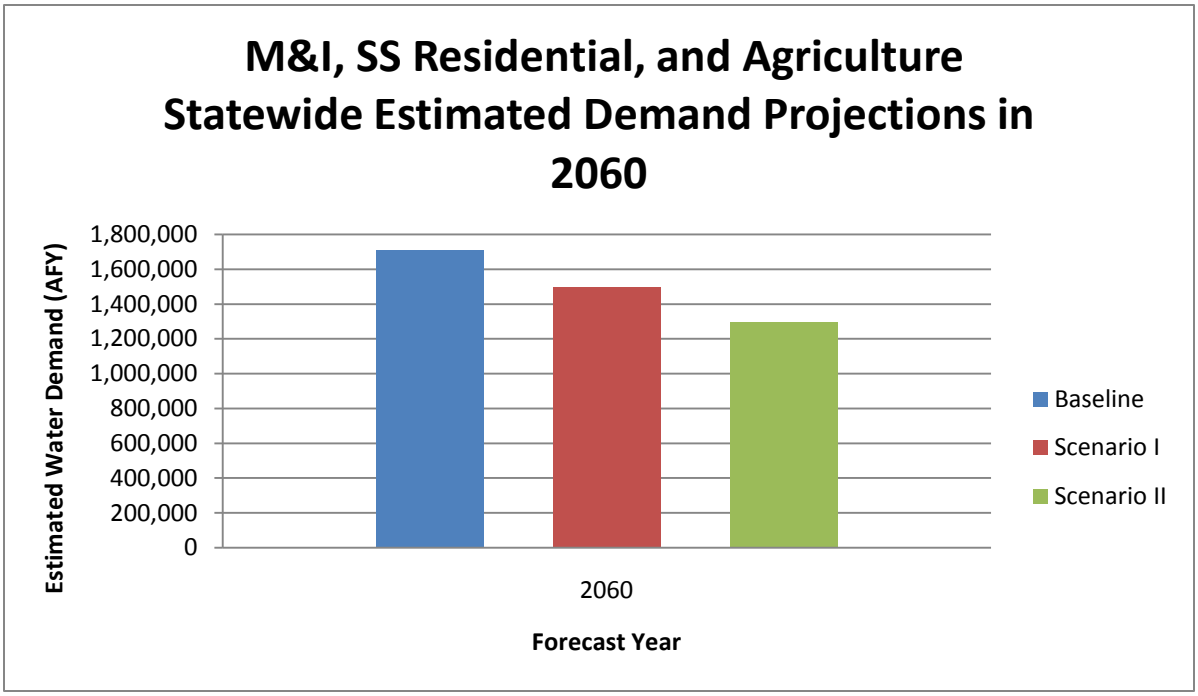


Figure 4: Combined PS Residential, PS Non-residential, SS Residential, and Agriculture Statewide Estimated Demand Projections in 2060.

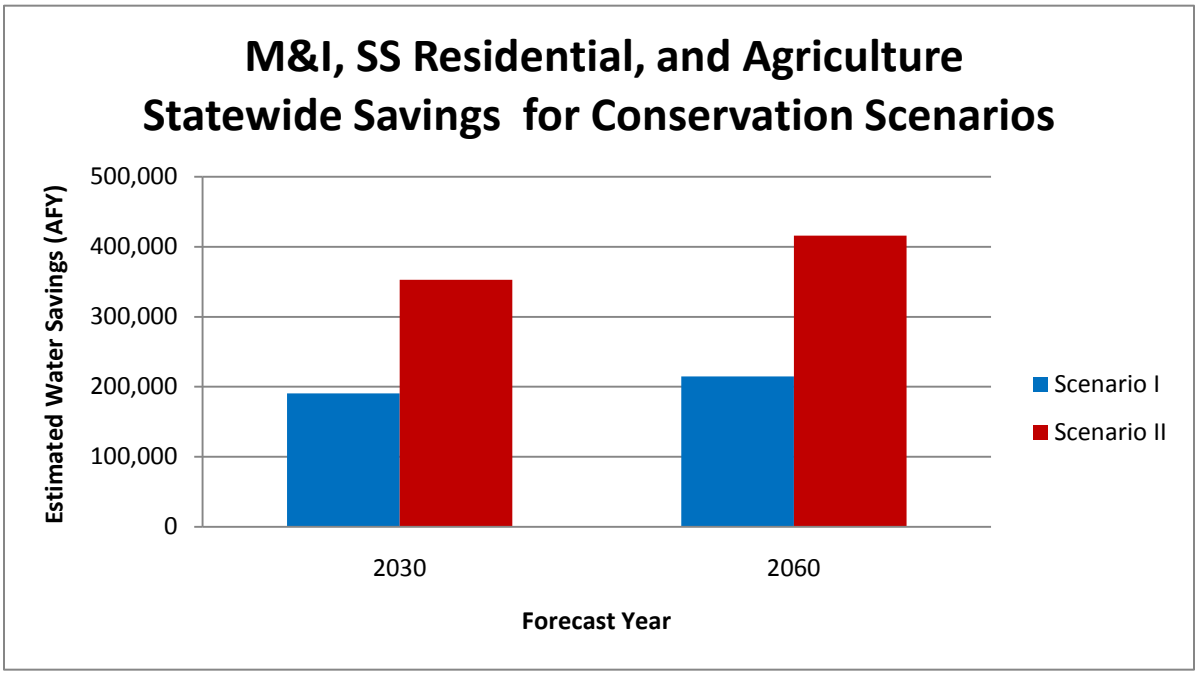


Figure 5: Combined PS Residential, PS Non-Residential, SS Residential, and Agriculture Statewide Estimated Water Savings in 2030 and 2060.

Section 3
Climate Change

3.1 Introduction

In support of IDIQ Task Order Number 1 (W912BV-09-D-1001) for the development of the Oklahoma Comprehensive Water Plan (OCWP), Task 2D.8, Investigate Climate Change "What if" Scenarios, this portion of the addendum provides a summary of the preliminary demand forecasts under selected climate change scenarios. Included is a brief description of the global climate change scenario data developed in related OCWP work by AMEC, the steps taken by CDM to transform the climate data, and how corresponding demand scenarios were developed for the Municipal and Industrial (M&I) and Irrigated Agriculture sectors.

3.2 Climate Change Scenario Analysis and Selection

Definition of future climate change scenarios is derived from contemporary climate simulation information. Climate simulation models have been developed and applied to estimate global and/or continental climatic conditions during the 21th century. These climate simulations must then be downscaled to the Oklahoma region.

According to a recent report by the U.S. Bureau of Reclamation, review of current downscaled climate projections over Oklahoma suggests that the southern Great Plains are likely to be warmer in the future, although the rate of warming varies. Projections of precipitation differ from model to model and range between drier and wetter than historical conditions (Bureau of Reclamation, 2010).

In order to assess the potential implication of surface water availability under climate change conditions, AMEC developed five climate change scenarios based on ensembles of climate projection models: Q1, Q2, Q3, Q4, and C. These five scenarios were developed for two different projection horizons: 2030 and 2060. AMEC also provided one dataset representing historical average conditions. The general implications of the five climate scenarios are shown in **Figure 6**. Q1 is a hot and dry scenario; Q4 is a warm wet scenario; Q2 and Q3 are interim scenarios; and "C" is the central tendency of Q1-Q4. There is slight variation in the scenarios from basin to basin, as further discussed below.

The AMEC methodology for developing climate projections closely followed that applied by the U.S. Bureau of Reclamation as part of their "ensemble hybrid-delta" method (BOR, 2010). Projections were developed based on differences in regional mean annual temperature and precipitation compared to the historical baseline. Q1 represents the ensemble projection developed from the set of individual projections with predicted mean annual temperature changes greater than the median projected change (upper half) and predicted mean annual precipitation changes less than the median projected change (lower half) (i.e. hot and dry). Similarly, Q2 is developed from the lower half of both the temperature and precipitation change; Q3 from the upper half of both temperature and precipitation change (hot and wet); and Q4 from the lower half of temperature change and upper half of precipitation change (warm and wet). The C scenario represents the pool of projections from the interquartile range of change projections: 25th to 75th percentile of both temperature and precipitation change. For each of the five scenarios, and each month, climate adjustment factor

distributions were calculated based on differences between the ensemble pools of data and the historical baseline data set. These adjustment factors were then applied to the historical timeseries data set to incorporate climate change impacts associated with the given planning horizon, while maintaining historical patterns of month to month variability.

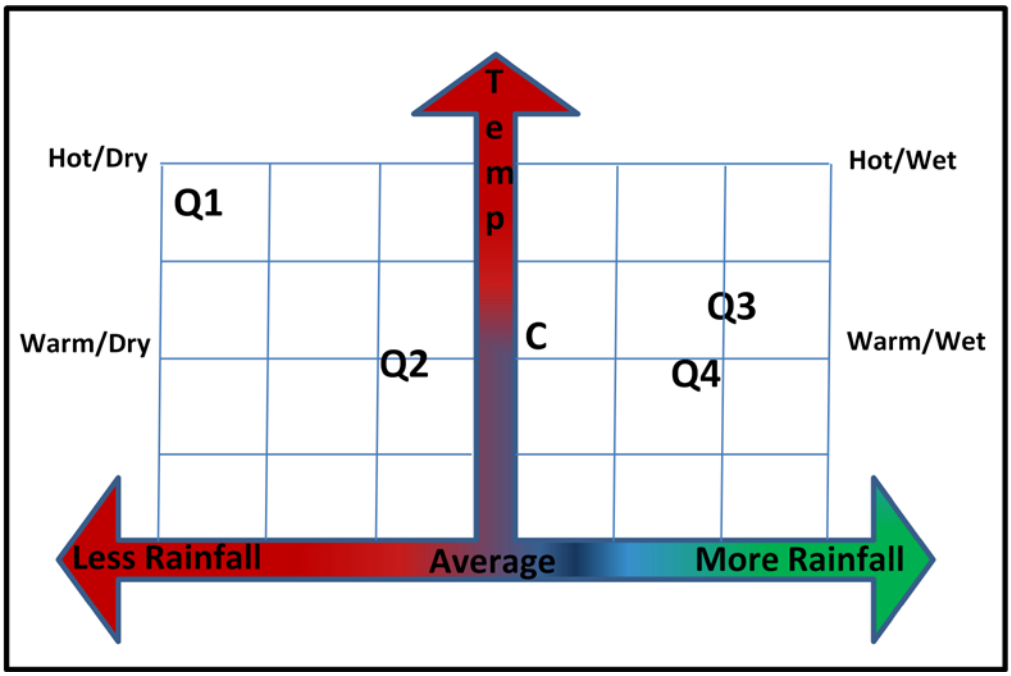


Figure 6: Climate Scenario Implications

Before analysis on the climate change scenario data could occur, the data had to be transformed to a usable format. The data were delivered to CDM in 11 folders, one for each of the five climate scenarios and planning horizon forecast (2030 and 2060) plus the historical dataset. Each climate scenario folder contained 82 text files representing OCWP planning basins with daily precipitation, wind speed, maximum and minimum temperature for 58 years from January 1, 1950 to December 31, 2007. A macro was developed by CDM to convert each of the text files into a Microsoft Excel file.

For demand forecast use, the basin for each county (for M&I projections) and agriculture station were identified and those basin data were imported into a Microsoft Access database. The basin that made up the largest area of a given county was designated as that county's primary basin and was used to represent the climate conditions for that county. Forty-nine of the 82 basins were identified as primary basins. The basin Excel files were imported into Access, thus creating a climate database. Queries were performed for quality assurance and control to ensure that every required Excel file was imported without duplicates.

From Access, a set of queries was applied to the selected climate database to transform the climate data into a usable format for input into the M&I and Irrigated Agricultural demand models, as follows:

- Converted the date column from bunched format (e.g., 19500101) to months and years (e.g., 01, 1950)

- Organized daily data into monthly data for each year and basin/scenario combination, daily precipitation values were summed for each month, and the daily temperatures and wind speed were converted to monthly values

- Averaged the monthly climate values for each month across all years to get the monthly means of the climate variables for each basin/scenario combination

The monthly climate data for the 77 counties and 11 stations were exported into an Excel file. The temperature units were converted from Celsius to Fahrenheit, precipitation from millimeters to inches, and wind speed from meters per second to miles per hour.

Climate Scenario Selection

Rather than create demand forecasts for each possible climate scenario, CDM analyzed the climate scenario data to confirm that Q1 and Q4 would bracket a range of potential climate change conditions. The climate scenario analysis was performed for Q1-Q4 and "C" scenarios using the 2060 planning horizon for five counties, four corners and a central location in Oklahoma. Results of the analysis are shown in **Figure 7** through **Figure 11** for the five locations.

The difference or Delta (Δ) in annual precipitation between the historical and climate scenarios was determined for each selected county. The Δ for average maximum temperatures in August was also determined for these scenarios. The temperature and precipitation Δ represents departure of the climate scenario from historic climate.

Inspection of Figure 2 through Figure 6 confirms that Q1 represents the hottest/driest scenario across Oklahoma. Likewise, Q4 represents the mildest change in temperature with a slight increase in precipitation, or a warm/wet scenario. These two scenarios do indeed have the largest variation in climate (of the scenarios evaluated here) and represent the extreme ends of predicted climate change and were thus selected for demand forecast sensitivity analysis. **Appendix C** provides precipitation and temperature variables by county for the historical dataset, Q1 (herein referred to as Hot/Dry), and Q4 (herein referred to as Warm/Wet). The statewide change in precipitation and temperature for the climate scenarios are shown in **Figure 12** and **Figure 13**, respectively.

Figure 7: Northwest Region Scenario Comparison

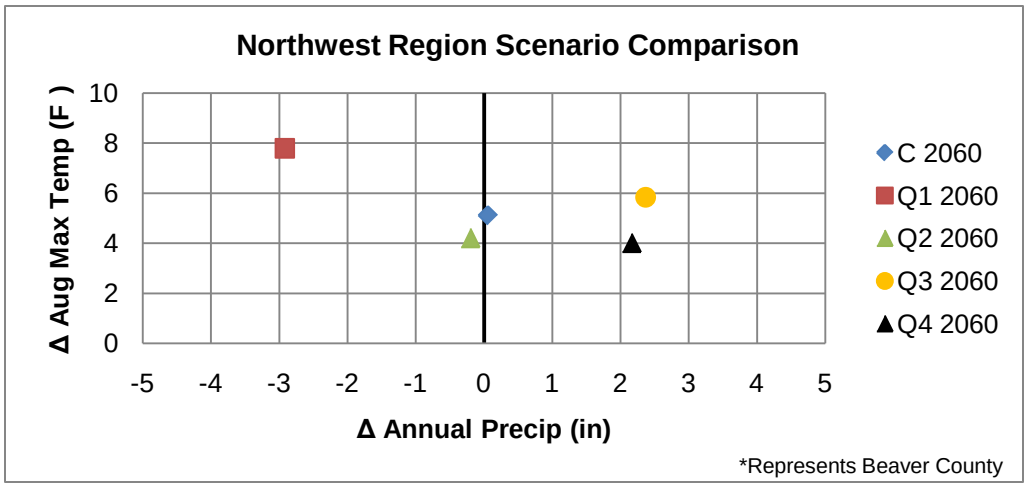


Figure 8: Southwest Region Scenario Comparison

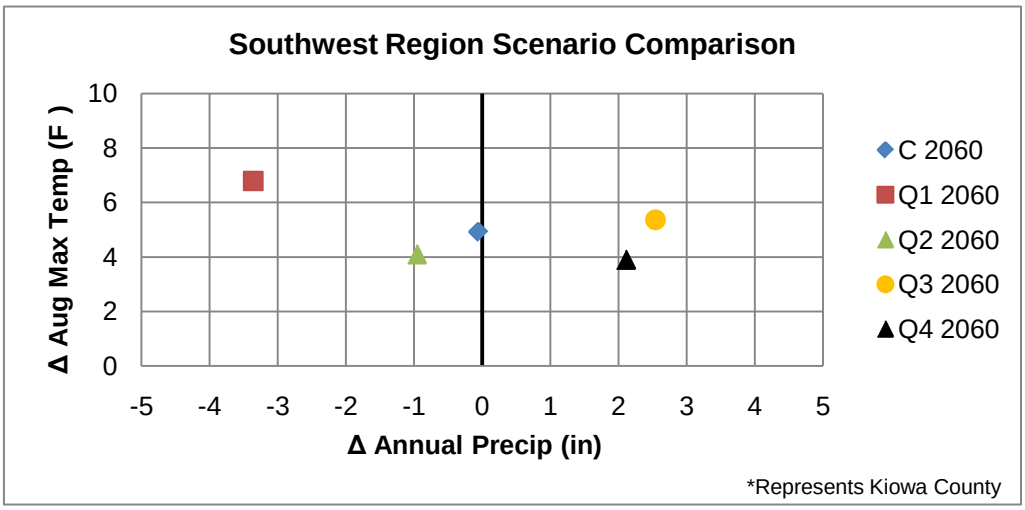


Figure 9: Northeast Region Scenario Comparison

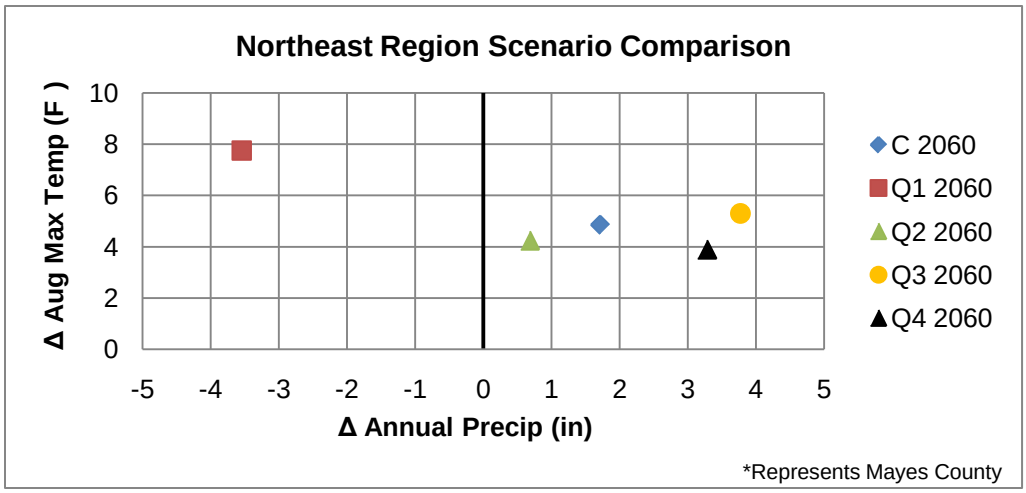


Figure 10: Central Region Scenario Comparison

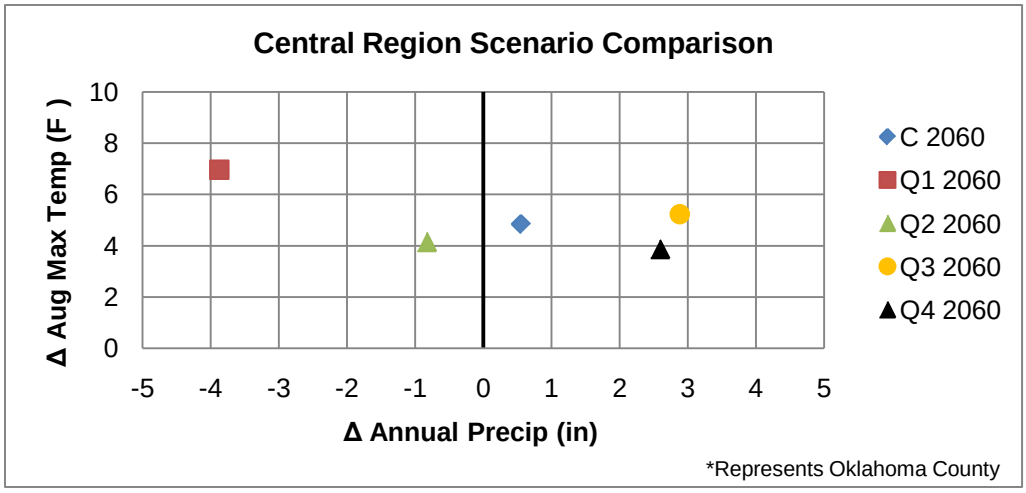


Figure 11: Southeast Region Scenario Comparison

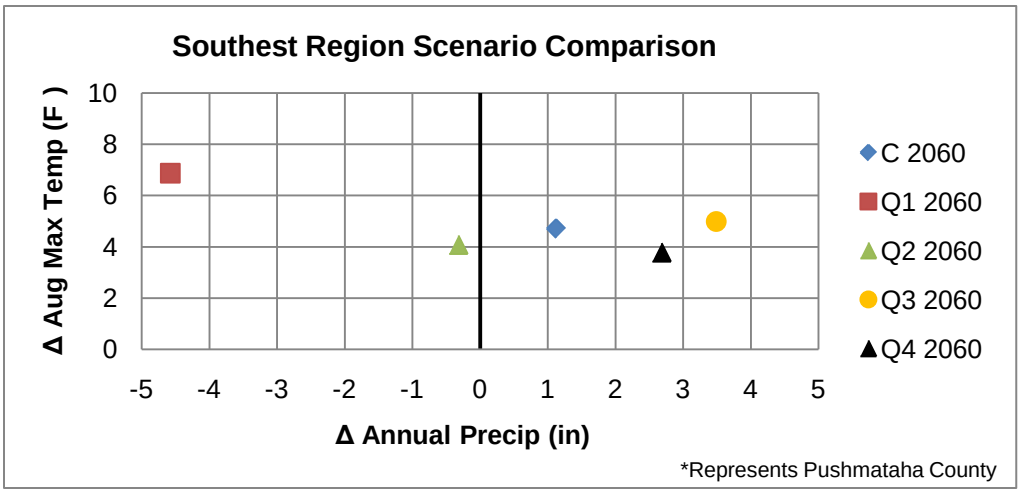


Figure 12: Change in 2060 Annual Precipitation (inches) from Historical Average for Scenarios Q1 and Q4

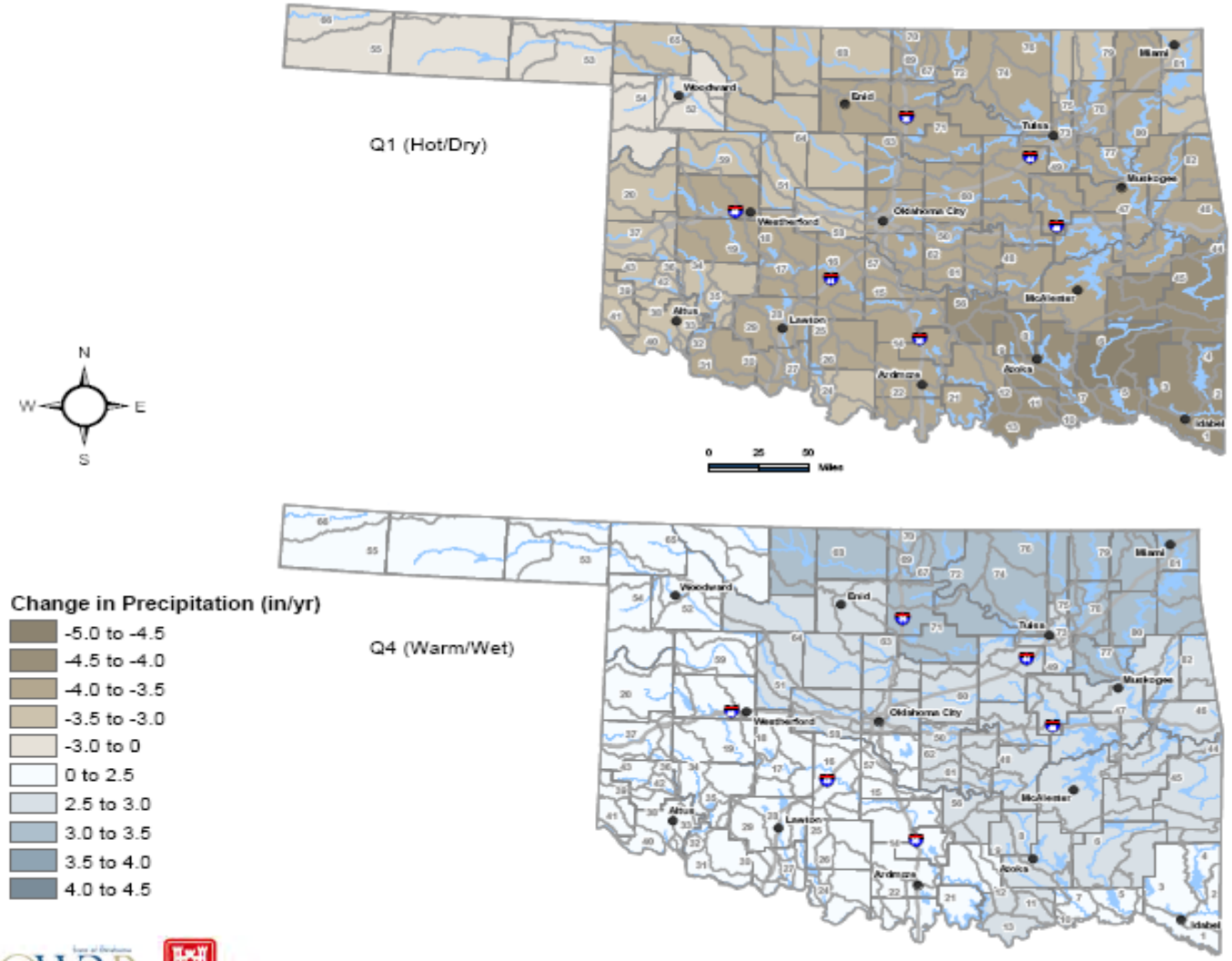
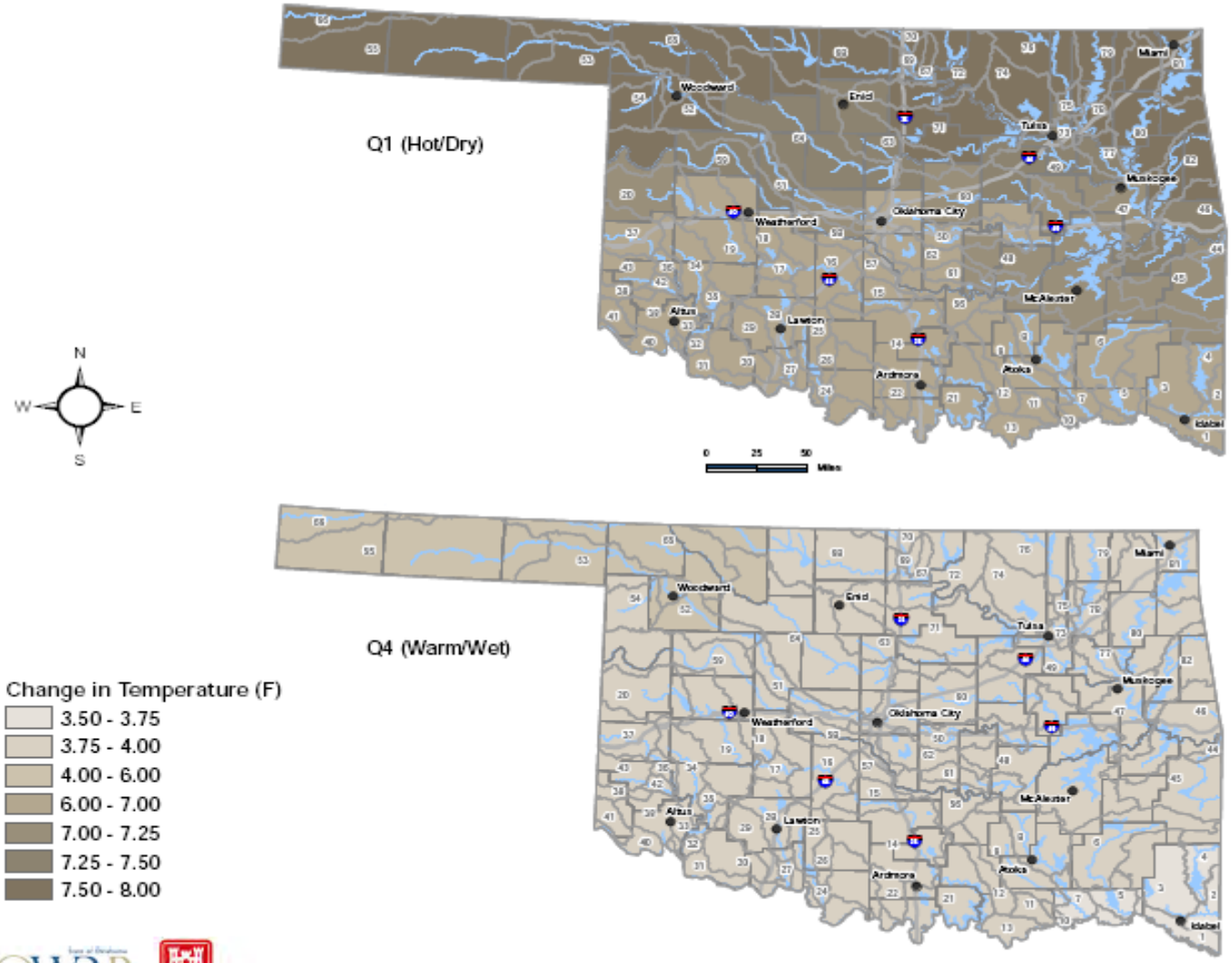


Figure 13: Change in 2060 Maximum Temperature in August (° Fahrenheit) from Historical Average for Scenarios Q1 and Q4



3.3 M&I Model and Results

Statistical results of the OCWP Climate Demand Model were used to model the impacts of climate change on M&I water demand (CDM Deliverable, "OCWP Weather Production Model Revised Final TM"). The Climate Demand Model was developed using regression analysis and assessed the relationship between weather and monthly water demand. These relationships are expressed as elasticities, or the percent change in monthly water production given a percent change in monthly weather.

Variation in both monthly average daily maximum temperature and monthly total precipitation were found to have statistically significant relationships with water production. The elasticities for maximum temperature and precipitation can be used to adjust monthly water production estimates for the potential shifts in maximum temperature and precipitation. The formula to estimate monthly water demand under climate change for a given scenario is shown in **Equation 23**.

$$QC_{my}^{c} = QB_{my}^{c} \times \left(\frac{mtC_{m}^{c}}{mtH_{m}^{c}}\right)^{emt_m} \times \left(\frac{pC_{m}^{c}}{pH_{m}^{c}}\right)^{ep_m}$$

Equation 23

Where:

QC_{my}^{c} = Climate adjusted total production for county (c) in month (m) and year (y)
QB_{my}^{c} = Baseline total production for county (c) in month (m) and year (y)
mtC_{m}^{c} = Estimated average maximum daily temperature under climate change for county (c) in month (m)
mtH_{m}^{c} = Historical average maximum daily temperature for county (c) in month (m)
emt_m = Elasticity of maximum temperature in month (m)
pC_{m}^{c} = Estimated monthly precipitation under climate change for county (c) in month (m)
pH_{m}^{c} = Historical average precipitation for county (c) in month (m)
ep_m = Elasticity of precipitation in month (m)

*Note that the term $\left(\frac{mtC_m^c}{mtH_m^c}\right)$ represents the Delta (Δ) in temperature and that $\left(\frac{pC_m^c}{pH_m^c}\right)$ represents the Delta (Δ) in precipitation.

M&I Results

Estimates were developed for county M&I demand under climate change scenarios using Equation 23, the baseline M&I demand, elasticities from the Weather Production Model, and average monthly weather data from the climate scenarios. **Table 8** provides the statewide M&I demand forecast summary for the Hot/Dry and Warm/Wet climate scenarios as well as the difference from the baseline forecast. The change in M&I county demand from baseline under climate change scenarios are displayed in **Figure 14**. The county M&I forecast under climate change is provided in tabular form in **Appendix D**.

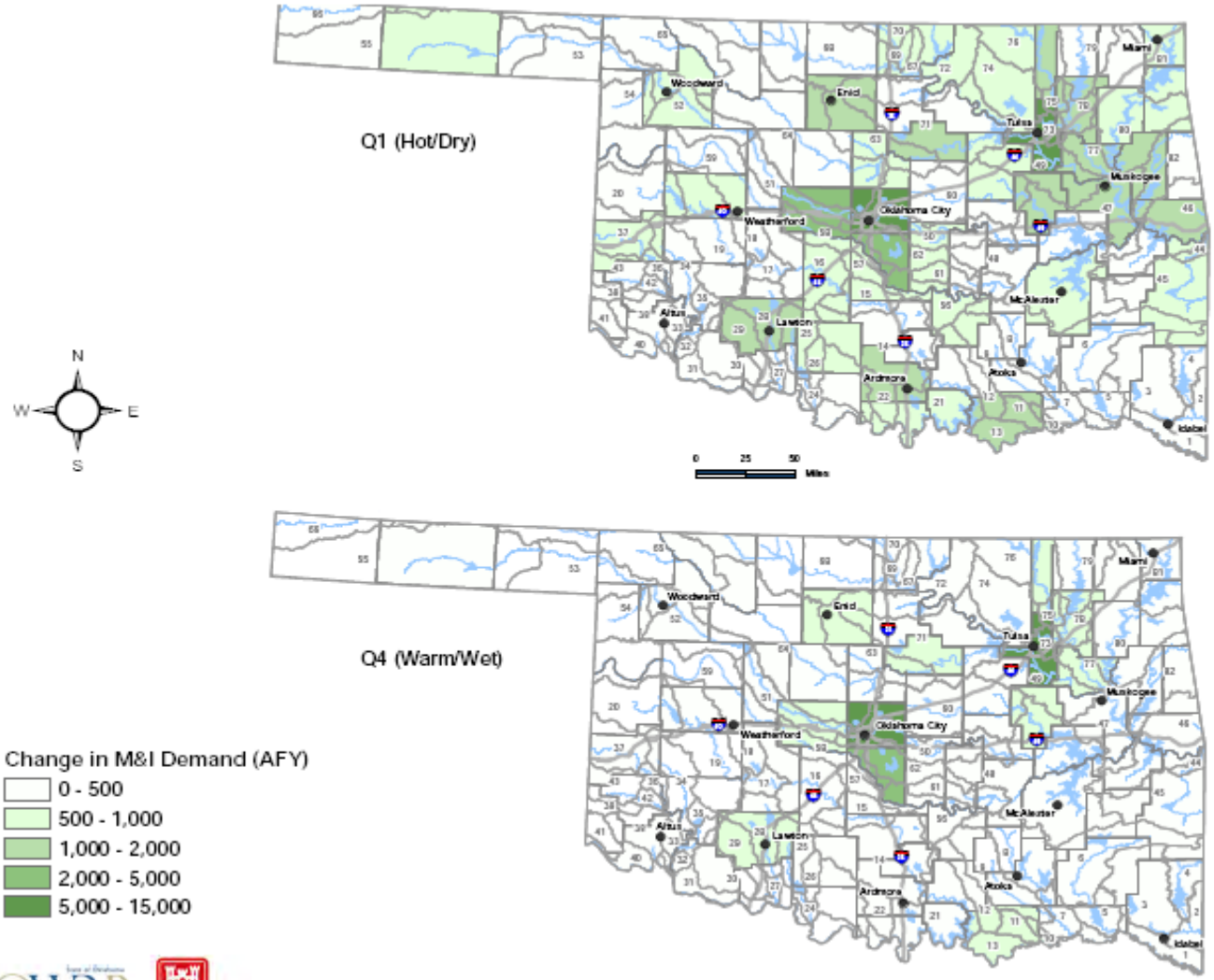
As expected, the 2060 Hot/Dry scenario produces the largest increase in M&I demand with a 9.5 percent increase from baseline. The Warm/Wet 2060 scenario produces an M&I demand increase of 4.2 percent. Demands for the Hot/Dry and Warm/Wet scenarios in 2030 are estimated to increase from the baseline forecast by 5.3 and 2.5 percent, respectively.

Table 8: Statewide M&I Demand Forecast Under Climate Change in AFY*

Year	Baseline	Hot/Dry	Warm/Wet
2007	583,901	n/a	n/a
2030	682,391	718,747	699,119
2060	772,773	846,029	805,398
Change from Baseline			
2030	n/a	36,356	16,727
2060	n/a	73,256	32,625
Percent Increase from Baseline			
2030	n/a	5.30%	2.50%
2060	n/a	9.50%	4.20%

*AFY= acre-feet per year

Figure 14: Change in M&I Water Demand (AFY) from Baseline for Scenarios Q1 and Q4



3.4 Irrigated Agriculture Model and Results

Climate change is assumed to impact only the Crop Irrigation demand and no change is assessed for the Livestock demand sector. Modeling climate change impacts on agriculture demand required adaptation and use of the model developed for the OCWP baseline forecast. The model considers a county's number of acres to be irrigated in the future, relative crop mix, monthly irrigation requirements for each crop, and losses due to irrigation system inefficiencies. The baseline forecast used monthly irrigation requirements for crops at 11 stations throughout Oklahoma, as reported in the NRCS Irrigation Guide Report, Oklahoma Supplement (Natural Resource Conservation Service, 2006).

For the climate change scenario forecast, it was assumed that the number of irrigated acres, relative mix of crops, and irrigation efficiencies would remain constant from the baseline forecast. Irrigation crop requirements by station are assumed to change given climate change scenarios.

Crop irrigation requirements under climate change were estimated using Irrigation Water Requirement, Penman-Monteith (IWRpm) program developed by the NRCS. The FAO Penman-Monteith (PM) method available in IWRpm is citied as providing the most accurate results, even with missing input data, and is the standard method used by the American Society of Civil Engineers (ASCE). Thus, CDM selected this method within IWRpm to estimate irrigation crop requirements under climate change scenarios.

The NRCS Irrigation Guide data utilized in the baseline forecast were developed using the Blaney-Criddle (BC) method. However, communications with NRCS employees indicated that the BC method is no longer the most desired choice in estimating plant water requirements. The FAO PM method will ultimately produce differing results, even if all other variables are held constant (including climate). In order to distinguish the changes in demand that occur solely from climate change and to minimize changes that may occur from differing methodologies, IWRpm was used to estimate irrigation requirements under historical average weather conditions and under climate change scenarios. The difference between historical average and climate change estimates of irrigation requirements created using IWRpm was then applied to the baseline irrigation requirements, as shown in **Equation 24**.

$$NC_s^m = \frac{(NB_s^m \times NCFAO_s^m)}{NHFAO_s^m}$$

Equation 24

Where:

NC_s^m = Net irrigation water requirement for input into demand model for month (m) and station (s)

NB_s^m = Net irrigation water requirement from the baseline model for month (m) and station (s)

$NCFAO_s^m$ = Net irrigation water requirement for a given climate scenario computed by IWRpm for month (m) and station (s)

$NHFAO_s^m$ = Net irrigation water requirement for historical average weather computed by IWRpm for month (m) and station (s)

The IWRpm program requires the development of a climate and crop database with the inputs derived from local conditions, where possible. The following sections describe how these databases were developed.

IWR Databases

The FAO PM method uses monthly climate data including: mean maximum and minimum temperatures, mean maximum and minimum relative humidity, mean wind speed, and solar radiation climate data. Solar radiation is not a required input and values of zero were entered for solar radiation and actual duration of sunshine. The scenarios selected for the irrigation model were limited to the Hot/Dry and Warm/Wet scenarios. As mentioned, data were also developed for historical average conditions.

Local weather conditions for the 11 stations were entered into the IWR climate database. For each station four copies were created with the same general station information and were named after the different station/climate scenario separating the 2030 and 2060 planning horizons. For each station/climate scenario the respective monthly precipitation, maximum and minimum temperatures, and wind data were entered into the climate database using the edit function. These values originated from the previously mentioned averaged monthly station data file. Mean monthly relative humidity was obtained from the Oklahoma Agweather and Oklahoma Mesonet website (AgWeatherMesonet). Humidity was considered not to vary with the climate change scenarios and remained constant for each of the climate scenarios.

The same list of crops used in the baseline forecast of the agricultural irrigation demand model was used to develop the crop database in IWRpm, excluding spinach and sod/turf. The list varies slightly by station but includes alfalfa, corn grain, corn silage, cotton, pasture grass, grain sorghum, peanuts, potatoes, soybeans, sunflower, wheat, and watermelons. Each crop required a designated crop coefficient Kc value from the program's FAO Table 12, as well as a crop growing stage value including Fs1, Fs2, and Fs3 values. The majority of the default settings for the final data entry and Kc computation were used, the exception was selecting the Sub-humid minimum relative humidity option. The default settings were similar to conditions found in Oklahoma and the IWRpm documentation suggested only changing the settings when specific local conditions were available (Dalton, 2006).

Once the crop and climate databases were established, the main IWRpm program was used to determine the crops' monthly irrigation requirements for each station/climate combination. The resulting monthly irrigation requirements IWRpm were then input into an Excel spreadsheet. Once the monthly irrigation requirements were in Excel, the final net irrigation requirements under climate change scenarios were developed using Equation 24.

Finally, the adjusted net irrigation water requirements under climate change by crop and station were input into the agriculture irrigation demand model by scenario (see baseline forecast documentation for methodology). The models were used to estimate climate scenario irrigation water demand for each county for the 2030 and 2060 planning horizons.

Irrigated Agriculture Results

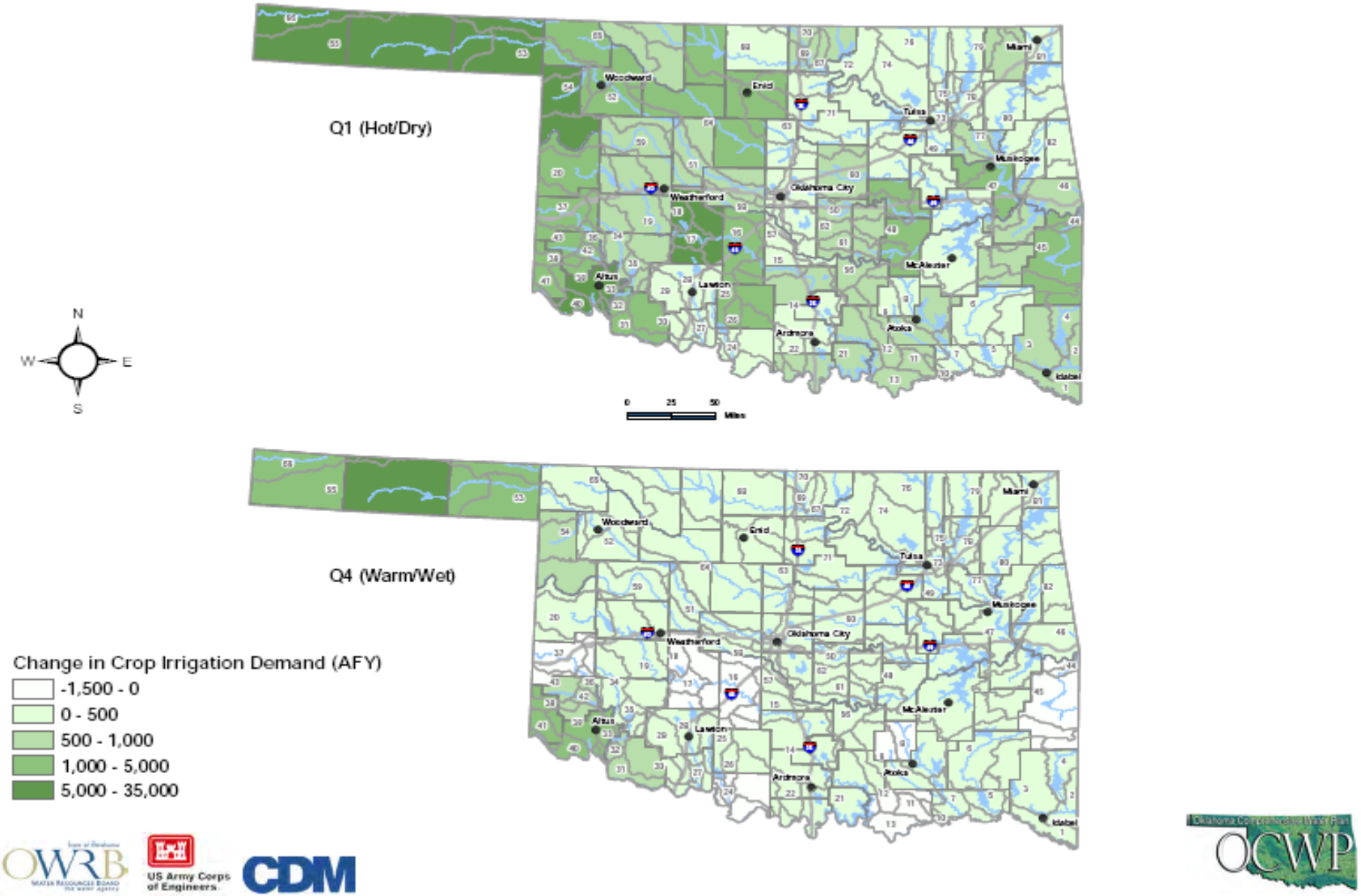
Table 9 provides a statewide summary of Irrigated Agriculture demand under baseline, Hot/Dry, and Warm/Wet conditions. County-level irrigation demands under climate change are provided in tabular form in Appendix D. Figure 15 provides the statewide change in Irrigated Agriculture demand from baseline for each scenario.

As shown, the range of increase for 2030 is 17,000 and 86,000 AFY, or 2.2 to 10.7 percent. The upper-end of the range doubles in 2060 to 143,000 AFY under the Hot/Dry scenario. This is an increase of 16.0 percent from the baseline forecast.

Table 9: Statewide Irrigated Agriculture Demand Forecast Under Climate Change in AFY

Year	Baseline	Hot/Dry	Warm/Wet
2007	736,074	n/a	n/a
2030	806,112	892,221	823,622
2060	897,464	1,041,032	926,557
Change from Baseline			
2030	n/a	86,109	17,511
2060	n/a	143,567	29,093
Percent Increase from Baseline			
2030	n/a	10.70%	2.20%
2060	n/a	16.00%	3.20%

Figure 15: Change in Agriculture Irrigation Water Demand (AFY) from Baseline for Scenarios Q1 and Q4



3.5 Combined Impacts

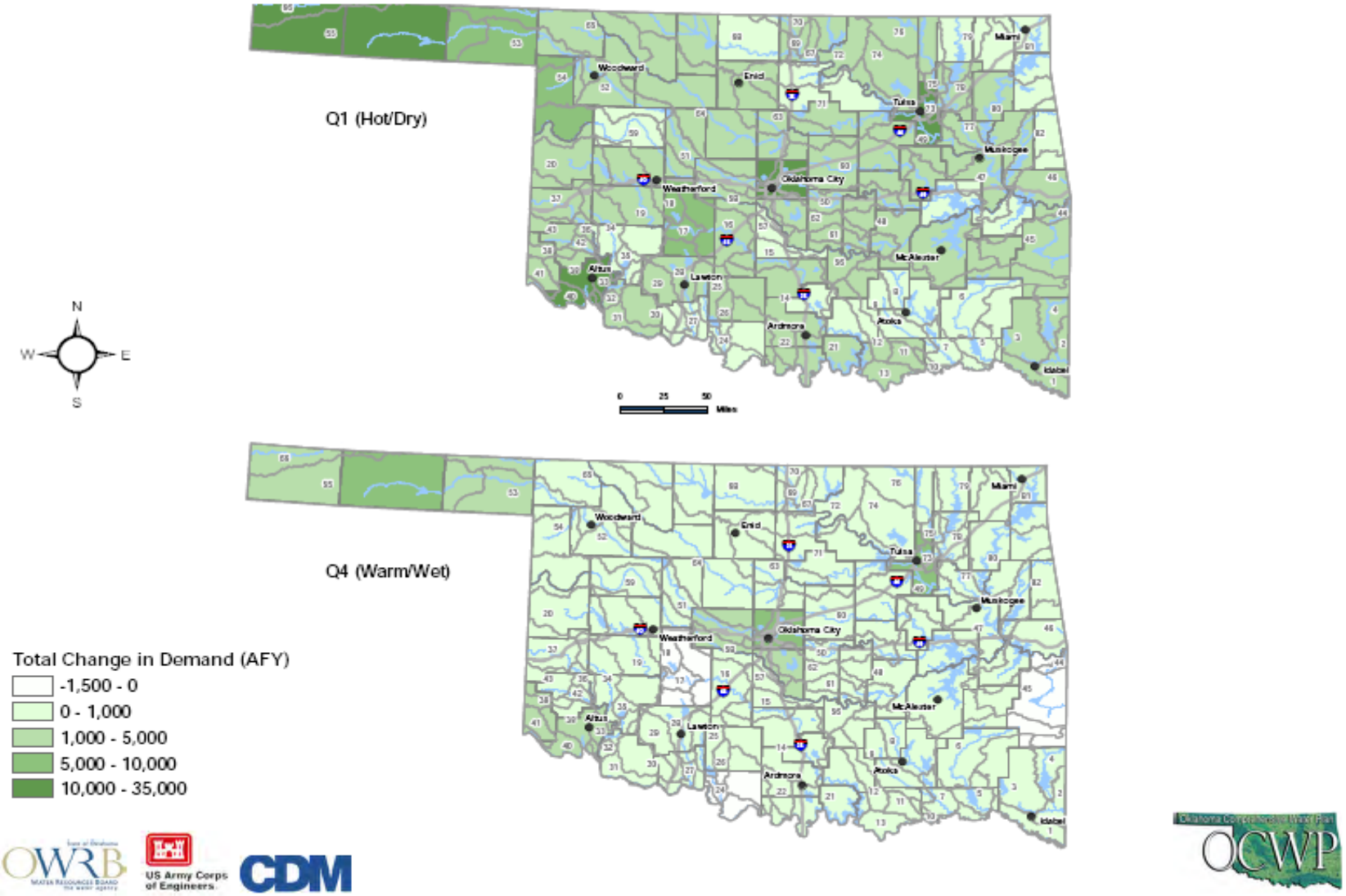
Table 10 provides the combined M&I and Irrigated Agriculture impacts from climate change scenarios. For 2030, the range of impact is estimated to be between 34,200 and 122,400 AFY, or 2.3 to 8.2 percent. For 2060, the range of impacts is estimate to be between 61,700 and 216,800 AFY, or 3.7 to 13.0 percent increases from baseline water demand estimates. Under the 2060 Warm/Wet scenario, M&I demand accounts for 60 percent of the variation. Conversely, under the 2060 Hot/Dry scenario, irrigated agriculture accounts for 66 percent of the variation.

Figure 16 displays the combined impacts from M&I and Irrigated Agriculture under climate change for the Hot/Dry and Warm/Wet scenarios. Areas with large quantities of irrigated agriculture and areas with high concentrations of population are estimated to experience the greatest increases in demand from potential climate change.

Table 10: Combined M&I and Irrigated Agriculture Demand Impacts Under Climate Change in AFY

Year	Baseline	Hot/Dry	Warm/Wet
2007	1,319,975	n/a	n/a
2030	1,488,503	1,610,968	1,522,741
2060	1,670,238	1,887,061	1,731,955
Change from Baseline			
2030	n/a	122,465	34,238
2060	n/a	216,823	61,718
Percent Increase from Baseline			
2030	n/a	8.20%	2.30%
2060	n/a	13.00%	3.70%

Figure 16: Combined Agriculture and M&I Changes in Water Demand (AFY) from Baseline for Scenario Q1 and Q4



Section 4
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Appendices

Appendix A
County Water Savings in AFY by Sector for Conservation Scenario I and Conservation Scenario II

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Adair	Public Supply Residential	Passive	283	391	283	391
		Metering	232	320	264	364
		Leak Detection	55	76	89	123
		Conservation Rates	0	0	19	27
		Education Programs	27	37	45	62
		High Efficiency Plumbing Standards	0	0	38	100
		Subtotal	597	824	739	1,068
	Public Supply Non-Residential	Passive	56	77	56	77
		Metering	136	188	155	214
		Leak Detection	32	44	53	72
		Education Programs	0	0	16	22
		High Efficiency Plumbing Standards	0	0	20	56
		Subtotal	224	309	300	442
	Self Supply Residential	Passive	203	280	203	280
		Education Programs	0	0	16	23
		High Efficiency Plumbing Standards	0	0	27	71
		Subtotal	203	280	247	374
	Irrigated Agriculture	Irrigation Savings	84	122	437	634
	Total County Conservation Savings		1,109	1,536	1,722	2,518
Alfalfa	Public Supply Residential	Passive	90	93	90	93
		Metering	0	0	0	0
		Leak Detection	0	0	0	0
		Conservation Rates	4	4	18	19
		Education Programs	19	20	32	33
		High Efficiency Plumbing Standards	0	0	13	24
		Subtotal	113	117	152	168
	Public Supply Non-Residential	Passive	11	12	11	12
		Metering	0	0	0	0
		Leak Detection	0	0	0	0
		Education Programs	0	0	5	5
		High Efficiency Plumbing Standards	0	0	4	9
		Subtotal	11	12	20	25
	Self Supply Residential	Passive	16	17	16	17
		Education Programs	0	0	3	3
		High Efficiency Plumbing Standards	0	0	2	4
		Subtotal	16	17	22	24
	Irrigated Agriculture	Irrigation Savings	330	405	437	634
	Total County Conservation Savings		471	550	631	852

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Atoka	Public Supply Residential	Passive	296	389	296	389
		Metering	0	0	0	0
		Leak Detection	107	140	174	229
		Conservation Rates	53	70	116	152
		Education Programs	54	71	90	118
		High Efficiency Plumbing Standards	0	0	40	99
		Subtotal	509	670	714	987
	Public Supply Non-Residential	Passive	35	46	35	46
		Metering	0	0	0	0
		Leak Detection	21	27	34	44
		Education Programs	0	0	10	14
		High Efficiency Plumbing Standards	0	0	13	33
		Subtotal	55	73	91	137
	Self Supply Residential	Passive	78	103	78	103
		Education Programs	0	0	12	16
		High Efficiency Plumbing Standards	0	0	11	26
		Subtotal	78	103	101	145
	Irrigated Agriculture	Irrigation Savings	93	130	1,521	1,865
	Total County Conservation Savings		735	975	2,427	3,133
Beaver	Public Supply Residential	Passive	49	52	49	52
		Metering	0	0	3	3
		Leak Detection	0	0	0	0
		Conservation Rates	0	0	0	0
		Education Programs	5	5	9	9
		High Efficiency Plumbing Standards	0	0	7	13
		Subtotal	54	57	68	77
	Public Supply Non-Residential	Passive	13	14	13	14
		Metering	0	0	2	3
		Leak Detection	0	0	0	0
		Education Programs	0	0	4	4
		High Efficiency Plumbing Standards	0	0	5	10
		Subtotal	13	14	25	31
	Self Supply Residential	Passive	47	49	47	49
		Education Programs	0	0	4	5
		High Efficiency Plumbing Standards	0	0	7	13
		Subtotal	47	49	58	66
	Irrigated Agriculture	Irrigation Savings	1,823	1,973	537	755
	Total County Conservation Savings		1,938	2,093	688	929

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Beckham	Public Supply Residential	Passive	387	482	387	482
		Metering	0	0	17	21
		Leak Detection	0	0	0	0
		Conservation Rates	0	0	0	0
		Education Programs	109	136	182	227
		High Efficiency Plumbing Standards	0	0	53	123
		Subtotal	496	618	639	853
	Public Supply Non-Residential	Passive	87	108	87	108
		Metering	0	0	9	11
		Leak Detection	0	0	0	0
		Education Programs	0	0	58	72
		High Efficiency Plumbing Standards	0	0	31	78
		Subtotal	87	108	185	269
	Self Supply Residential	Passive	43	54	43	54
		Education Programs	0	0	11	14
		High Efficiency Plumbing Standards	0	0	6	14
		Subtotal	43	54	60	82
	Irrigated Agriculture	Irrigation Savings	484	484	10,235	11,078
	Total County Conservation Savings		1,111	1,265	11,119	12,283
Blaine	Public Supply Residential	Passive	240	300	240	300
		Metering	245	306	293	365
		Leak Detection	0	0	0	0
		Conservation Rates	0	0	0	0
		Education Programs	69	86	115	143
		High Efficiency Plumbing Standards	0	0	33	76
		Subtotal	554	692	680	885
	Public Supply Non-Residential	Passive	31	39	31	39
		Metering	57	71	68	85
		Leak Detection	0	0	0	0
		Education Programs	0	0	16	20
		High Efficiency Plumbing Standards	0	0	11	28
		Subtotal	89	111	127	173
	Self Supply Residential	Passive	24	30	24	30
		Education Programs	0	0	7	8
		High Efficiency Plumbing Standards	0	0	3	8
		Subtotal	24	30	34	46
	Irrigated Agriculture	Irrigation Savings	362	362	1,181	1,181
	Total County Conservation Savings		1,029	1,194	2,022	2,284

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Bryan	Public Supply Residential	Passive	746	943	746	943
		Metering	0	0	31	39
		Leak Detection	82	104	231	292
		Conservation Rates	0	0	38	48
		Education Programs	132	167	220	279
		High Efficiency Plumbing Standards	0	0	101	241
		Subtotal	961	1,214	1,368	1,842
	Public Supply Non-Residential	Passive	164	208	164	208
		Metering	0	0	14	17
		Leak Detection	37	46	103	130
		Education Programs	0	0	59	74
		High Efficiency Plumbing Standards	0	0	59	150
		Subtotal	201	254	399	579
	Self Supply Residential	Passive	56	71	56	71
		Education Programs	0	0	9	11
		High Efficiency Plumbing Standards	0	0	8	18
		Subtotal	56	71	73	100
	Irrigated Agriculture	Irrigation Savings	974	1,010	686	686
	Total County Conservation Savings		2,192	2,550	2,525	3,207
Caddo	Public Supply Residential	Passive	319	347	319	347
		Metering	117	128	169	183
		Leak Detection	0	0	0	0
		Conservation Rates	14	15	66	71
		Education Programs	49	53	82	89
		High Efficiency Plumbing Standards	0	0	44	89
		Subtotal	500	544	679	779
	Public Supply Non-Residential	Passive	67	73	67	73
		Metering	46	50	66	72
		Leak Detection	0	0	0	0
		Education Programs	0	0	19	21
		High Efficiency Plumbing Standards	0	0	24	53
		Subtotal	113	123	177	219
	Self Supply Residential	Passive	213	232	213	232
		Education Programs	0	0	29	32
		High Efficiency Plumbing Standards	0	0	30	59
		Subtotal	213	232	272	323
	Irrigated Agriculture	Irrigation Savings	2,051	2,502	1,728	1,791
	Total County Conservation Savings		2,877	3,400	2,857	3,113

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Canadian	Public Supply Residential	Passive	2,031	2,357	2,031	2,357
		Metering	1,587	1,842	1,851	2,148
		Leak Detection	0	0	41	48
		Conservation Rates	0	0	240	279
		Education Programs	267	310	445	516
		High Efficiency Plumbing Standards	0	0	278	601
		Subtotal	3,886	4,509	4,887	5,949
	Public Supply Non-Residential	Passive	245	285	245	285
		Metering	579	671	675	783
		Leak Detection	0	0	15	17
		Education Programs	0	0	97	113
		High Efficiency Plumbing Standards	0	0	89	206
		Subtotal	824	956	1,121	1,404
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	375	412	5,528	6,743
	Total County Conservation Savings		5,085	5,876	11,536	14,096
Carter	Public Supply Residential	Passive	953	1,104	953	1,104
		Metering	0	0	0	0
		Leak Detection	109	126	245	284
		Conservation Rates	25	29	150	174
		Education Programs	88	102	147	170
		High Efficiency Plumbing Standards	0	0	131	282
		Subtotal	1,175	1,361	1,626	2,014
	Public Supply Non-Residential	Passive	213	247	213	247
		Metering	0	0	0	0
		Leak Detection	66	77	150	173
		Education Programs	0	0	54	62
		High Efficiency Plumbing Standards	0	0	77	178
		Subtotal	280	324	494	661
	Self Supply Residential	Passive	4	5	4	5
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	1	1
		Subtotal	4	5	5	7
	Irrigated Agriculture	Irrigation Savings	156	162	1,186	1,301
	Total County Conservation Savings		1,615	1,853	3,310	3,983

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Cherokee	Public Supply Residential	Passive	900	1,207	900	1,207
		Metering	60	80	180	242
		Leak Detection	205	276	335	449
		Conservation Rates	18	24	138	185
		Education Programs	135	181	225	302
		High Efficiency Plumbing Standards	0	0	121	308
		Subtotal	1,317	1,767	1,898	2,693
	Public Supply Non-Residential	Passive	157	210	157	210
		Metering	27	36	82	110
		Leak Detection	93	125	152	204
		Education Programs	0	0	61	82
		High Efficiency Plumbing Standards	0	0	57	152
		Subtotal	277	372	508	758
	Self Supply Residential	Passive	176	236	176	236
		Education Programs	0	0	22	30
		High Efficiency Plumbing Standards	0	0	24	60
		Subtotal	176	236	222	327
	Irrigated Agriculture	Irrigation Savings	91	103	339	352
	Total County Conservation Savings		1,862	2,478	2,968	4,129
Choctaw	Public Supply Residential	Passive	196	211	196	211
		Metering	0	0	0	0
		Leak Detection	28	30	47	50
		Conservation Rates	16	18	34	37
		Education Programs	26	28	43	46
		High Efficiency Plumbing Standards	0	0	27	54
		Subtotal	266	286	347	397
	Public Supply Non-Residential	Passive	42	45	42	45
		Metering	0	0	0	0
		Leak Detection	25	27	42	45
		Education Programs	0	0	23	25
		High Efficiency Plumbing Standards	0	0	15	32
		Subtotal	66	71	122	147
	Self Supply Residential	Passive	89	96	89	96
		Education Programs	0	0	10	11
		High Efficiency Plumbing Standards	0	0	12	24
		Subtotal	89	96	112	131
	Irrigated Agriculture	Irrigation Savings	64	89	468	529
	Total County Conservation Savings		486	542	1,048	1,204

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Cimarron	Public Supply Residential	Passive	30	32	30	32
		Metering	0	0	0	0
		Leak Detection	20	22	33	35
		Conservation Rates	0	0	0	0
		Education Programs	18	19	30	32
		High Efficiency Plumbing Standards	0	0	4	8
		Subtotal	68	72	97	107
	Public Supply Non-Residential	Passive	7	7	7	7
		Metering	0	0	0	0
		Leak Detection	4	4	6	6
		Education Programs	0	0	3	3
		High Efficiency Plumbing Standards	0	0	2	5
		Subtotal	10	11	18	22
	Self Supply Residential	Passive	22	23	22	23
		Education Programs	0	0	11	12
		High Efficiency Plumbing Standards	0	0	3	6
		Subtotal	22	23	36	41
	Irrigated Agriculture	Irrigation Savings	4,015	4,948	342	473
	Total County Conservation Savings		4,115	5,054	494	642
Cleveland	Public Supply Residential	Passive	4,571	5,033	4,571	5,033
		Metering	0	0	0	0
		Leak Detection	727	801	1,400	1,541
		Conservation Rates	0	0	59	65
		Education Programs	360	396	600	661
		High Efficiency Plumbing Standards	0	0	628	1,284
		Subtotal	5,659	6,230	7,258	8,584
	Public Supply Non-Residential	Passive	704	775	704	775
		Metering	0	0	0	0
		Leak Detection	277	305	534	588
		Education Programs	0	0	137	151
		High Efficiency Plumbing Standards	0	0	254	560
		Subtotal	982	1,081	1,630	2,074
	Self Supply Residential	Passive	259	285	259	285
		Education Programs	0	0	18	19
		High Efficiency Plumbing Standards	0	0	36	73
		Subtotal	259	285	312	377
	Irrigated Agriculture	Irrigation Savings	83	115	17,669	21,776
	Total County Conservation Savings		6,982	7,710	26,869	32,811

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Coal	Public Supply Residential	Passive	97	136	97	136
		Metering	0	0	9	13
		Leak Detection	21	30	34	48
		Conservation Rates	0	0	0	0
		Education Programs	4	6	7	10
		High Efficiency Plumbing Standards	0	0	13	35
		Subtotal	122	172	160	242
	Public Supply Non-Residential	Passive	11	16	11	16
		Metering	0	0	3	4
		Leak Detection	6	9	10	15
		Education Programs	0	0	1	2
		High Efficiency Plumbing Standards	0	0	4	11
		Subtotal	18	25	30	47
	Self Supply Residential	Passive	37	52	37	52
		Education Programs	0	0	1	2
		High Efficiency Plumbing Standards	0	0	5	13
		Subtotal	37	52	43	67
	Irrigated Agriculture	Irrigation Savings	36	36	168	232
	Total County Conservation Savings		212	284	400	589
Comanche	Public Supply Residential	Passive	2,361	2,570	2,361	2,570
		Metering	2,072	2,256	2,322	2,528
		Leak Detection	0	0	206	224
		Conservation Rates	331	361	581	633
		Education Programs	44	47	73	79
		High Efficiency Plumbing Standards	0	0	325	656
		Subtotal	4,807	5,233	5,868	6,690
	Public Supply Non-Residential	Passive	393	428	393	428
		Metering	1,031	1,122	1,155	1,257
		Leak Detection	0	0	103	112
		Education Programs	0	0	22	24
		High Efficiency Plumbing Standards	0	0	142	309
		Subtotal	1,424	1,550	1,814	2,130
	Self Supply Residential	Passive	46	50	46	50
		Education Programs	0	0	1	1
		High Efficiency Plumbing Standards	0	0	6	13
		Subtotal	46	50	53	64
	Irrigated Agriculture	Irrigation Savings	172	205	168	170
	Total County Conservation Savings		6,449	7,039	7,904	9,054

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Cotton	Public Supply Residential	Passive	117	124	117	124
		Metering	60	64	71	75
		Leak Detection	18	19	29	31
		Conservation Rates	0	0	3	3
		Education Programs	16	17	26	28
		High Efficiency Plumbing Standards	0	0	16	32
		Subtotal	211	223	262	292
	Public Supply Non-Residential	Passive	14	15	14	15
		Metering	35	37	41	43
		Leak Detection	10	11	17	18
		Education Programs	0	0	9	9
		High Efficiency Plumbing Standards	0	0	5	10
		Subtotal	58	62	85	95
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	43	60	594	710
	Total County Conservation Savings		312	345	942	1,097
Craig	Public Supply Residential	Passive	31	40	31	40
		Metering	0	0	21	27
		Leak Detection	61	78	99	128
		Conservation Rates	14	18	49	64
		Education Programs	54	69	89	115
		High Efficiency Plumbing Standards	0	0	4	10
		Subtotal	160	205	295	384
	Public Supply Non-Residential	Passive	60	77	60	77
		Metering	0	0	11	15
		Leak Detection	33	42	53	68
		Education Programs	0	0	29	37
		High Efficiency Plumbing Standards	0	0	22	56
		Subtotal	92	119	175	253
	Self Supply Residential	Passive	2	2	2	2
		Education Programs	0	0	3	3
		High Efficiency Plumbing Standards	0	0	0	1
		Subtotal	2	2	5	6
	Irrigated Agriculture	Irrigation Savings	63	144	55	77
	Total County Conservation Savings		316	471	529	721

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Creek	Public Supply Residential	Passive	1,183	1,350	1,183	1,350
		Metering	0	0	96	109
		Leak Detection	216	246	351	401
		Conservation Rates	63	71	189	216
		Education Programs	147	168	245	280
		High Efficiency Plumbing Standards	0	0	163	345
		Subtotal	1,608	1,835	2,227	2,700
	Public Supply Non-Residential	Passive	163	186	163	186
		Metering	0	0	46	53
		Leak Detection	105	119	170	195
		Education Programs	0	0	71	81
		High Efficiency Plumbing Standards	0	0	59	135
		Subtotal	268	306	511	650
	Self Supply Residential	Passive	135	153	135	153
		Education Programs	0	0	14	16
		High Efficiency Plumbing Standards	0	0	19	39
		Subtotal	135	153	167	209
	Irrigated Agriculture	Irrigation Savings	24	31	294	677
	Total County Conservation Savings		2,035	2,325	3,199	4,235
Custer	Public Supply Residential	Passive	453	497	453	497
		Metering	273	299	350	383
		Leak Detection	37	41	122	133
		Conservation Rates	24	27	101	111
		Education Programs	115	126	192	211
		High Efficiency Plumbing Standards	0	0	63	127
		Subtotal	903	989	1,280	1,461
	Public Supply Non-Residential	Passive	107	118	107	118
		Metering	143	156	183	200
		Leak Detection	19	21	64	70
		Education Programs	0	0	60	66
		High Efficiency Plumbing Standards	0	0	39	85
		Subtotal	269	295	453	539
	Self Supply Residential	Passive	66	72	66	72
		Education Programs	0	0	15	16
		High Efficiency Plumbing Standards	0	0	9	18
		Subtotal	66	72	90	107
	Irrigated Agriculture	Irrigation Savings	266	280	77	99
	Total County Conservation Savings		1,504	1,637	1,900	2,206

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Delaware	Public Supply Residential	Passive	699	957	699	957
		Metering	149	204	226	309
		Leak Detection	130	178	212	291
		Conservation Rates	56	77	133	182
		Education Programs	105	144	176	240
		High Efficiency Plumbing Standards	0	0	94	244
		Subtotal	1,140	1,562	1,538	2,224
	Public Supply Non-Residential	Passive	84	116	84	116
		Metering	61	84	92	126
		Leak Detection	53	73	87	119
		Education Programs	0	0	43	59
		High Efficiency Plumbing Standards	0	0	30	84
		Subtotal	199	272	337	504
	Self Supply Residential	Passive	278	381	278	381
		Education Programs	0	0	36	49
		High Efficiency Plumbing Standards	0	0	37	97
		Subtotal	278	381	351	527
	Irrigated Agriculture	Irrigation Savings	53	53	778	821
	Total County Conservation Savings		1,669	2,268	3,005	4,076
Dewey	Public Supply Residential	Passive	60	62	60	62
		Metering	0	0	18	19
		Leak Detection	15	15	35	36
		Conservation Rates	9	9	27	28
		Education Programs	27	28	45	47
		High Efficiency Plumbing Standards	0	0	8	16
		Subtotal	111	116	194	209
	Public Supply Non-Residential	Passive	11	12	11	12
		Metering	0	0	5	5
		Leak Detection	4	4	9	10
		Education Programs	0	0	7	7
		High Efficiency Plumbing Standards	0	0	4	9
		Subtotal	15	16	37	43
	Self Supply Residential	Passive	20	20	20	20
		Education Programs	0	0	8	8
		High Efficiency Plumbing Standards	0	0	3	5
		Subtotal	20	20	30	34
	Irrigated Agriculture	Irrigation Savings	264	264	267	267
	Total County Conservation Savings		410	417	528	553

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Ellis	Public Supply Residential	Passive	47	47	47	47
		Metering	0	0	0	0
		Leak Detection	19	19	31	31
		Conservation Rates	1	1	12	12
		Education Programs	17	17	28	28
		High Efficiency Plumbing Standards	0	0	7	12
		Subtotal	84	84	125	130
	Public Supply Non-Residential	Passive	9	9	9	9
		Metering	0	0	0	0
		Leak Detection	6	6	9	9
		Education Programs	0	0	5	5
		High Efficiency Plumbing Standards	0	0	3	7
		Subtotal	15	15	27	30
	Self Supply Residential	Passive	26	26	26	26
		Education Programs	0	0	8	8
		High Efficiency Plumbing Standards	0	0	4	7
		Subtotal	26	26	37	40
	Irrigated Agriculture	Irrigation Savings	1,527	1,932	929	929
	Total County Conservation Savings		1,651	2,056	1,118	1,129
Garfield	Public Supply Residential	Passive	1,085	1,151	1,085	1,151
		Metering	0	0	11	11
		Leak Detection	306	324	498	528
		Conservation Rates	177	188	356	378
		Education Programs	28	30	47	50
		High Efficiency Plumbing Standards	0	0	151	294
		Subtotal	1,596	1,693	2,148	2,412
	Public Supply Non-Residential	Passive	230	244	230	244
		Metering	0	0	5	5
		Leak Detection	139	148	227	241
		Education Programs	0	0	13	14
		High Efficiency Plumbing Standards	0	0	83	176
		Subtotal	369	391	557	679
	Self Supply Residential	Passive	28	30	28	30
		Education Programs	0	0	1	1
		High Efficiency Plumbing Standards	0	0	4	8
		Subtotal	28	30	33	38
	Irrigated Agriculture	Irrigation Savings	74	74	11,179	14,145
	Total County Conservation Savings		2,066	2,187	13,917	17,274

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Garvin	Public Supply Residential	Passive	432	457	432	457
		Metering	34	36	98	103
		Leak Detection	109	115	177	188
		Conservation Rates	0	0	42	44
		Education Programs	77	81	128	135
		High Efficiency Plumbing Standards	0	0	60	117
		Subtotal	651	690	936	1,045
	Public Supply Non-Residential	Passive	84	89	84	89
		Metering	19	20	56	59
		Leak Detection	62	66	101	107
		Education Programs	0	0	44	46
		High Efficiency Plumbing Standards	0	0	30	64
		Subtotal	165	175	315	366
	Self Supply Residential	Passive	78	83	78	83
		Education Programs	0	0	12	12
		High Efficiency Plumbing Standards	0	0	11	21
		Subtotal	78	83	101	116
	Irrigated Agriculture	Irrigation Savings	112	182	1,144	1,144
	Total County Conservation Savings		1,006	1,129	2,496	2,670
Grady	Public Supply Residential	Passive	688	790	688	790
		Metering	38	44	109	125
		Leak Detection	121	139	197	227
		Conservation Rates	0	0	38	44
		Education Programs	99	113	164	189
		High Efficiency Plumbing Standards	0	0	94	201
		Subtotal	945	1,086	1,291	1,576
	Public Supply Non-Residential	Passive	125	144	125	144
		Metering	25	28	71	81
		Leak Detection	78	90	128	147
		Education Programs	0	0	64	73
		High Efficiency Plumbing Standards	0	0	45	104
		Subtotal	228	262	432	549
	Self Supply Residential	Passive	310	356	310	356
		Education Programs	0	0	38	43
		High Efficiency Plumbing Standards	0	0	43	91
		Subtotal	310	356	391	491
	Irrigated Agriculture	Irrigation Savings	627	627	336	546
	Total County Conservation Savings		2,111	2,331	2,450	3,161

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Grant	Public Supply Residential	Passive	73	77	73	77
		Metering	2	2	13	14
		Leak Detection	18	19	30	31
		Conservation Rates	0	0	7	7
		Education Programs	17	18	28	29
		High Efficiency Plumbing Standards	0	0	10	20
		Subtotal	109	115	160	178
	Public Supply Non-Residential	Passive	10	11	10	11
		Metering	1	1	4	5
		Leak Detection	6	6	10	10
		Education Programs	0	0	6	6
		High Efficiency Plumbing Standards	0	0	4	8
		Subtotal	17	18	34	40
	Self Supply Residential	Passive	12	13	12	13
		Education Programs	0	0	2	3
		High Efficiency Plumbing Standards	0	0	2	3
		Subtotal	12	13	16	19
	Irrigated Agriculture	Irrigation Savings	100	100	1,657	1,657
	Total County Conservation Savings		238	246	1,868	1,894
Greer	Public Supply Residential	Passive	112	118	112	118
		Metering	0	0	0	0
		Leak Detection	0	0	0	0
		Conservation Rates	17	18	34	35
		Education Programs	25	27	42	44
		High Efficiency Plumbing Standards	0	0	16	30
		Subtotal	154	162	204	228
	Public Supply Non-Residential	Passive	14	15	14	15
		Metering	0	0	0	0
		Leak Detection	0	0	0	0
		Education Programs	0	0	6	7
		High Efficiency Plumbing Standards	0	0	5	11
		Subtotal	14	15	25	32
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	553	900	340	340
	Total County Conservation Savings		721	1,077	569	599

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Harmon	Public Supply Residential	Passive	53	58	53	58
		Metering	0	0	0	0
		Leak Detection	24	26	39	42
		Conservation Rates	0	0	14	15
		Education Programs	21	23	35	38
		High Efficiency Plumbing Standards	0	0	7	15
		Subtotal	98	106	148	168
	Public Supply Non-Residential	Passive	8	9	8	9
		Metering	0	0	0	0
		Leak Detection	4	4	7	7
		Education Programs	0	0	4	4
		High Efficiency Plumbing Standards	0	0	3	6
		Subtotal	12	13	21	26
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	4,194	4,525	2,191	3,569
	Total County Conservation Savings		4,303	4,645	2,360	3,763
Harper	Public Supply Residential	Passive	42	44	42	44
		Metering	51	52	66	68
		Leak Detection	26	26	42	43
		Conservation Rates	0	0	6	6
		Education Programs	21	21	35	36
		High Efficiency Plumbing Standards	0	0	6	11
		Subtotal	140	144	197	208
	Public Supply Non-Residential	Passive	12	12	12	12
		Metering	15	15	19	20
		Leak Detection	8	8	12	13
		Education Programs	0	0	6	6
		High Efficiency Plumbing Standards	0	0	4	9
		Subtotal	34	35	54	60
	Self Supply Residential	Passive	18	18	18	18
		Education Programs	0	0	7	8
		High Efficiency Plumbing Standards	0	0	2	5
		Subtotal	18	18	28	31
	Irrigated Agriculture	Irrigation Savings	607	713	5,645	6,092
	Total County Conservation Savings		799	910	5,923	6,389

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Haskell	Public Supply Residential	Passive	176	239	176	239
		Metering	0	0	0	0
		Leak Detection	31	42	50	68
		Conservation Rates	0	0	0	0
		Education Programs	27	37	45	61
		High Efficiency Plumbing Standards	0	0	24	61
		Subtotal	233	317	294	428
	Public Supply Non-Residential	Passive	40	54	40	54
		Metering	0	0	0	0
		Leak Detection	26	35	42	57
		Education Programs	0	0	23	31
		High Efficiency Plumbing Standards	0	0	14	39
		Subtotal	65	89	118	181
	Self Supply Residential	Passive	137	186	137	186
		Education Programs	0	0	18	24
		High Efficiency Plumbing Standards	0	0	18	47
		Subtotal	137	186	173	258
	Irrigated Agriculture	Irrigation Savings	167	202	4,712	5,534
	Total County Conservation Savings		602	794	5,297	6,401
Hughes	Public Supply Residential	Passive	294	387	294	387
		Metering	171	225	204	269
		Leak Detection	58	76	94	123
		Conservation Rates	12	16	46	60
		Education Programs	51	67	84	111
		High Efficiency Plumbing Standards	0	0	40	99
		Subtotal	585	770	762	1,050
	Public Supply Non-Residential	Passive	30	39	30	39
		Metering	49	65	59	78
		Leak Detection	17	22	27	36
		Education Programs	0	0	15	19
		High Efficiency Plumbing Standards	0	0	11	28
		Subtotal	96	126	141	200
	Self Supply Residential	Passive	22	29	22	29
		Education Programs	0	0	3	4
		High Efficiency Plumbing Standards	0	0	3	7
		Subtotal	22	29	28	40
	Irrigated Agriculture	Irrigation Savings	298	471	910	1,099
	Total County Conservation Savings		1,000	1,395	1,841	2,389

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Jackson	Public Supply Residential	Passive	469	511	469	511
		Metering	0	0	42	46
		Leak Detection	114	124	186	203
		Conservation Rates	44	48	111	121
		Education Programs	100	109	167	182
		High Efficiency Plumbing Standards	0	0	65	131
		Subtotal	728	793	1,040	1,193
	Public Supply Non-Residential	Passive	105	114	105	114
		Metering	0	0	22	24
		Leak Detection	61	66	99	108
		Education Programs	0	0	54	58
		High Efficiency Plumbing Standards	0	0	38	83
		Subtotal	166	181	318	388
	Self Supply Residential	Passive	21	22	21	22
		Education Programs	0	0	4	4
		High Efficiency Plumbing Standards	0	0	3	6
		Subtotal	21	22	27	32
	Irrigated Agriculture	Irrigation Savings	20,947	22,164	1,430	2,261
	Total County Conservation Savings		21,861	23,160	2,815	3,874
Jefferson	Public Supply Residential	Passive	111	119	111	119
		Metering	103	111	116	124
		Leak Detection	21	23	35	37
		Conservation Rates	0	0	12	13
		Education Programs	4	4	7	7
		High Efficiency Plumbing Standards	0	0	15	30
		Subtotal	239	257	295	331
	Public Supply Non-Residential	Passive	12	13	12	13
		Metering	31	33	35	37
		Leak Detection	6	7	10	11
		Education Programs	0	0	1	1
		High Efficiency Plumbing Standards	0	0	4	9
		Subtotal	49	53	62	71
	Self Supply Residential	Passive	3	3	3	3
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	1
		Subtotal	3	3	3	3
	Irrigated Agriculture	Irrigation Savings	20	25	22,559	23,869
	Total County Conservation Savings		311	337	22,919	24,275

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Johnston	Public Supply Residential	Passive	230	307	230	307
		Metering	189	252	222	295
		Leak Detection	56	74	91	121
		Conservation Rates	1	1	33	44
		Education Programs	27	36	45	60
		High Efficiency Plumbing Standards	0	0	31	78
		Subtotal	503	669	652	904
	Public Supply Non-Residential	Passive	30	40	30	40
		Metering	66	87	77	102
		Leak Detection	19	26	31	42
		Education Programs	0	0	9	12
		High Efficiency Plumbing Standards	0	0	11	29
		Subtotal	115	153	159	226
	Self Supply Residential	Passive	2	3	2	3
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	1
		Subtotal	2	3	3	4
	Irrigated Agriculture	Irrigation Savings	109	171	31	38
	Total County Conservation Savings		729	996	844	1,172
Kay	Public Supply Residential	Passive	831	890	831	890
		Metering	585	627	675	723
		Leak Detection	153	164	250	267
		Conservation Rates	0	0	45	48
		Education Programs	116	124	193	206
		High Efficiency Plumbing Standards	0	0	115	227
		Subtotal	1,685	1,805	2,109	2,362
	Public Supply Non-Residential	Passive	186	200	186	200
		Metering	492	527	568	608
		Leak Detection	129	138	210	225
		Education Programs	0	0	97	104
		High Efficiency Plumbing Standards	0	0	67	144
		Subtotal	807	865	1,129	1,281
	Self Supply Residential	Passive	43	46	43	46
		Education Programs	0	0	5	5
		High Efficiency Plumbing Standards	0	0	6	12
		Subtotal	43	46	54	63
	Irrigated Agriculture	Irrigation Savings	255	255	467	730
	Total County Conservation Savings		2,790	2,970	3,758	4,436

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Kingfisher	Public Supply Residential	Passive	222	288	222	288
		Metering	0	0	28	36
		Leak Detection	70	91	115	149
		Conservation Rates	19	25	60	78
		Education Programs	28	37	47	61
		High Efficiency Plumbing Standards	0	0	30	73
		Subtotal	340	440	502	685
	Public Supply Non-Residential	Passive	60	77	60	77
		Metering	0	0	20	25
		Leak Detection	50	65	81	105
		Education Programs	0	0	20	26
		High Efficiency Plumbing Standards	0	0	21	56
		Subtotal	109	142	202	289
	Self Supply Residential	Passive	86	112	86	112
		Education Programs	0	0	9	12
		High Efficiency Plumbing Standards	0	0	12	29
		Subtotal	86	112	107	153
	Irrigated Agriculture	Irrigation Savings	484	550	452	452
	Total County Conservation Savings		1,020	1,244	1,263	1,579
Kiowa	Public Supply Residential	Passive	177	186	177	186
		Metering	0	0	6	6
		Leak Detection	28	30	46	48
		Conservation Rates	0	0	11	11
		Education Programs	25	26	41	43
		High Efficiency Plumbing Standards	0	0	25	48
		Subtotal	230	242	306	343
	Public Supply Non-Residential	Passive	23	24	23	24
		Metering	0	0	3	3
		Leak Detection	16	16	25	27
		Education Programs	0	0	14	14
		High Efficiency Plumbing Standards	0	0	8	17
		Subtotal	39	40	74	86
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	640	691	1,988	2,258
	Total County Conservation Savings		909	973	2,368	2,687

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Latimer	Public Supply Residential	Passive	177	209	177	209
		Metering	0	0	9	11
		Leak Detection	59	70	96	114
		Conservation Rates	35	41	69	82
		Education Programs	52	61	87	102
		High Efficiency Plumbing Standards	0	0	24	53
		Subtotal	322	381	462	571
	Public Supply Non-Residential	Passive	38	45	38	45
		Metering	0	0	4	5
		Leak Detection	26	31	43	51
		Education Programs	0	0	23	27
		High Efficiency Plumbing Standards	0	0	14	33
		Subtotal	65	77	122	161
	Self Supply Residential	Passive	25	30	25	30
		Education Programs	0	0	6	8
		High Efficiency Plumbing Standards	0	0	3	8
		Subtotal	25	30	35	45
	Irrigated Agriculture	Irrigation Savings	103	186	1,306	1,408
	Total County Conservation Savings		515	673	1,926	2,185
Le Flore	Public Supply Residential	Passive	855	1,014	855	1,014
		Metering	263	311	364	432
		Leak Detection	173	206	283	335
		Conservation Rates	116	137	218	258
		Education Programs	138	164	230	273
		High Efficiency Plumbing Standards	0	0	117	259
		Subtotal	1,544	1,832	2,066	2,571
	Public Supply Non-Residential	Passive	125	148	125	148
		Metering	124	147	173	205
		Leak Detection	82	97	134	159
		Education Programs	0	0	65	77
		High Efficiency Plumbing Standards	0	0	45	107
		Subtotal	331	393	541	696
	Self Supply Residential	Passive	125	149	125	149
		Education Programs	0	0	17	20
		High Efficiency Plumbing Standards	0	0	17	38
		Subtotal	125	149	160	207
	Irrigated Agriculture	Irrigation Savings	198	198	568	1,029
	Total County Conservation Savings		2,198	2,571	3,335	4,502

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Lincoln	Public Supply Residential	Passive	296	358	296	358
		Metering	69	84	101	122
		Leak Detection	54	65	88	106
		Conservation Rates	8	10	40	48
		Education Programs	47	57	79	96
		High Efficiency Plumbing Standards	0	0	40	91
		Subtotal	474	574	643	821
	Public Supply Non-Residential	Passive	71	86	71	86
		Metering	51	61	74	90
		Leak Detection	40	48	65	78
		Education Programs	0	0	35	42
		High Efficiency Plumbing Standards	0	0	26	62
		Subtotal	161	195	270	358
	Self Supply Residential	Passive	357	432	357	432
		Education Programs	0	0	49	59
		High Efficiency Plumbing Standards	0	0	49	110
		Subtotal	357	432	454	601
	Irrigated Agriculture	Irrigation Savings	199	199	976	976
	Total County Conservation Savings		1,191	1,400	2,344	2,756
Logan	Public Supply Residential	Passive	552	702	552	702
		Metering	505	643	599	762
		Leak Detection	160	203	260	331
		Conservation Rates	61	78	155	197
		Education Programs	93	118	155	197
		High Efficiency Plumbing Standards	0	0	75	179
		Subtotal	1,370	1,743	1,795	2,367
	Public Supply Non-Residential	Passive	70	89	70	89
		Metering	129	164	153	195
		Leak Detection	41	52	67	85
		Education Programs	0	0	24	30
		High Efficiency Plumbing Standards	0	0	25	64
		Subtotal	240	305	339	463
	Self Supply Residential	Passive	247	314	247	314
		Education Programs	0	0	35	45
		High Efficiency Plumbing Standards	0	0	33	80
		Subtotal	247	314	315	439
	Irrigated Agriculture	Irrigation Savings	111	111	1,042	1,042
	Total County Conservation Savings		1,968	2,473	3,491	4,311

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Love	Public Supply Residential	Passive	447	533	447	533
		Metering	327	389	380	452
		Leak Detection	90	107	147	175
		Conservation Rates	0	0	38	45
		Education Programs	57	68	95	113
		High Efficiency Plumbing Standards	0	0	61	136
		Subtotal	921	1,097	1,168	1,454
	Public Supply Non-Residential	Passive	88	105	88	105
		Metering	348	414	404	481
		Leak Detection	96	114	156	186
		Education Programs	0	0	61	72
		High Efficiency Plumbing Standards	0	0	32	76
		Subtotal	531	633	740	919
	Self Supply Residential	Passive	16	19	16	19
		Education Programs	0	0	2	2
		High Efficiency Plumbing Standards	0	0	2	5
		Subtotal	16	19	20	26
	Irrigated Agriculture	Irrigation Savings	205	285	471	471
	Total County Conservation Savings		1,673	2,034	2,399	2,871
Major	Public Supply Residential	Passive	92	96	92	96
		Metering	53	56	65	68
		Leak Detection	4	4	17	18
		Conservation Rates	0	0	0	0
		Education Programs	8	8	13	13
		High Efficiency Plumbing Standards	0	0	13	24
		Subtotal	157	164	200	219
	Public Supply Non-Residential	Passive	21	22	21	22
		Metering	39	41	48	50
		Leak Detection	3	3	12	13
		Education Programs	0	0	6	6
		High Efficiency Plumbing Standards	0	0	8	16
		Subtotal	63	66	94	106
	Self Supply Residential	Passive	38	39	38	39
		Education Programs	0	0	3	3
		High Efficiency Plumbing Standards	0	0	5	10
		Subtotal	38	39	46	52
	Irrigated Agriculture	Irrigation Savings	726	733	655	909
	Total County Conservation Savings		984	1,002	995	1,287

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Marshall	Public Supply Residential	Passive	408	620	408	620
		Metering	0	0	13	20
		Leak Detection	78	119	127	193
		Conservation Rates	37	57	83	127
		Education Programs	69	104	114	174
		High Efficiency Plumbing Standards	0	0	54	158
		Subtotal	592	900	800	1,293
	Public Supply Non-Residential	Passive	75	114	75	114
		Metering	0	0	12	18
		Leak Detection	70	106	114	173
		Education Programs	0	0	61	93
		High Efficiency Plumbing Standards	0	0	27	82
		Subtotal	144	220	289	480
	Self Supply Residential	Passive	19	28	19	28
		Education Programs	0	0	3	4
		High Efficiency Plumbing Standards	0	0	2	7
		Subtotal	19	28	24	40
	Irrigated Agriculture	Irrigation Savings	254	277	2,780	2,808
	Total County Conservation Savings		1,010	1,426	3,892	4,620
Mayes	Public Supply Residential	Passive	839	1,054	839	1,054
		Metering	63	79	156	196
		Leak Detection	159	200	259	325
		Conservation Rates	93	117	186	234
		Education Programs	104	131	174	218
		High Efficiency Plumbing Standards	0	0	114	269
		Subtotal	1,258	1,580	1,728	2,296
	Public Supply Non-Residential	Passive	111	139	111	139
		Metering	25	32	62	78
		Leak Detection	64	80	104	130
		Education Programs	0	0	42	53
		High Efficiency Plumbing Standards	0	0	40	101
		Subtotal	200	251	359	501
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	78	96	331	361
	Total County Conservation Savings		1,536	1,928	2,417	3,158

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
McClain	Public Supply Residential	Passive	559	762	559	762
		Metering	0	0	0	0
		Leak Detection	138	189	226	307
		Conservation Rates	122	166	203	277
		Education Programs	122	166	203	277
		High Efficiency Plumbing Standards	0	0	75	195
		Subtotal	941	1,283	1,266	1,818
	Public Supply Non-Residential	Passive	77	105	77	105
		Metering	0	0	0	0
		Leak Detection	47	64	76	104
		Education Programs	0	0	41	56
		High Efficiency Plumbing Standards	0	0	28	76
		Subtotal	124	169	222	341
	Self Supply Residential	Passive	170	232	170	232
		Education Programs	0	0	32	43
		High Efficiency Plumbing Standards	0	0	23	59
		Subtotal	170	232	224	334
	Irrigated Agriculture	Irrigation Savings	163	171	410	504
	Total County Conservation Savings		1,398	1,855	2,122	2,997
McCurtain	Public Supply Residential	Passive	489	532	489	532
		Metering	270	293	332	361
		Leak Detection	106	115	173	188
		Conservation Rates	57	62	119	130
		Education Programs	29	31	48	52
		High Efficiency Plumbing Standards	0	0	68	136
		Subtotal	950	1,034	1,228	1,398
	Public Supply Non-Residential	Passive	98	106	98	106
		Metering	137	149	168	183
		Leak Detection	54	58	88	95
		Education Programs	0	0	14	16
		High Efficiency Plumbing Standards	0	0	35	77
		Subtotal	288	313	403	477
	Self Supply Residential	Passive	141	153	141	153
		Education Programs	0	0	7	8
		High Efficiency Plumbing Standards	0	0	19	39
		Subtotal	141	153	167	200
	Irrigated Agriculture	Irrigation Savings	0	0	307	323
	Total County Conservation Savings		1,378	1,500	2,105	2,397

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
McIntosh	Public Supply Residential	Passive	470	644	470	644
		Metering	76	104	122	167
		Leak Detection	78	106	126	173
		Conservation Rates	0	0	9	12
		Education Programs	44	60	74	101
		High Efficiency Plumbing Standards	0	0	63	164
		Subtotal	667	915	863	1,260
	Public Supply Non-Residential	Passive	44	61	44	61
		Metering	26	36	42	58
		Leak Detection	27	37	44	60
		Education Programs	0	0	15	21
		High Efficiency Plumbing Standards	0	0	16	44
		Subtotal	98	134	162	244
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	38	38	364	644
	Total County Conservation Savings		803	1,087	1,389	2,148
Murray	Public Supply Residential	Passive	278	350	278	350
		Metering	92	117	138	175
		Leak Detection	46	59	96	122
		Conservation Rates	0	0	27	35
		Education Programs	54	68	90	113
		High Efficiency Plumbing Standards	0	0	38	89
		Subtotal	470	593	667	884
	Public Supply Non-Residential	Passive	53	66	53	66
		Metering	37	47	55	70
		Leak Detection	19	23	39	49
		Education Programs	0	0	22	27
		High Efficiency Plumbing Standards	0	0	19	48
		Subtotal	108	136	187	260
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	18	42	137	138
	Total County Conservation Savings		597	772	991	1,282

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Muskogee	Public Supply Residential	Passive	1,206	1,297	1,206	1,297
		Metering	175	188	314	337
		Leak Detection	0	0	0	0
		Conservation Rates	97	105	237	254
		Education Programs	179	193	299	322
		High Efficiency Plumbing Standards	0	0	167	331
		Subtotal	1,658	1,783	2,223	2,542
	Public Supply Non-Residential	Passive	270	291	270	291
		Metering	99	106	178	191
		Leak Detection	0	0	0	0
		Education Programs	0	0	102	109
		High Efficiency Plumbing Standards	0	0	98	210
		Subtotal	369	397	647	801
	Self Supply Residential	Passive	129	138	129	138
		Education Programs	0	0	18	20
		High Efficiency Plumbing Standards	0	0	18	35
		Subtotal	129	138	165	193
	Irrigated Agriculture	Irrigation Savings	466	466	40	91
	Total County Conservation Savings		2,622	2,784	3,074	3,627
Noble	Public Supply Residential	Passive	188	202	188	202
		Metering	5	6	26	28
		Leak Detection	11	12	33	36
		Conservation Rates	5	5	25	27
		Education Programs	30	32	50	54
		High Efficiency Plumbing Standards	0	0	26	52
		Subtotal	240	258	348	398
	Public Supply Non-Residential	Passive	41	44	41	44
		Metering	4	5	21	22
		Leak Detection	9	10	27	29
		Education Programs	0	0	24	26
		High Efficiency Plumbing Standards	0	0	15	32
		Subtotal	55	59	128	154
	Self Supply Residential	Passive	30	32	30	32
		Education Programs	0	0	4	4
		High Efficiency Plumbing Standards	0	0	4	8
		Subtotal	30	32	38	45
	Irrigated Agriculture	Irrigation Savings	68	68	1,599	1,599
	Total County Conservation Savings		392	417	2,113	2,195

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Nowata	Public Supply Residential	Passive	235	318	235	318
		Metering	54	73	76	103
		Leak Detection	38	51	62	83
		Conservation Rates	22	30	45	60
		Education Programs	30	40	50	67
		High Efficiency Plumbing Standards	0	0	32	81
		Subtotal	379	513	499	713
	Public Supply Non-Residential	Passive	19	25	19	25
		Metering	14	20	20	28
		Leak Detection	10	14	17	22
		Education Programs	0	0	8	11
		High Efficiency Plumbing Standards	0	0	7	18
		Subtotal	43	58	70	104
	Self Supply Residential	Passive	16	22	16	22
		Education Programs	0	0	2	2
		High Efficiency Plumbing Standards	0	0	2	6
		Subtotal	16	22	20	30
	Irrigated Agriculture	Irrigation Savings	34	64	357	357
	Total County Conservation Savings		473	657	947	1,204
Okfuskee	Public Supply Residential	Passive	187	202	187	202
		Metering	0	0	0	0
		Leak Detection	37	40	60	65
		Conservation Rates	0	0	14	15
		Education Programs	33	35	54	59
		High Efficiency Plumbing Standards	0	0	26	51
		Subtotal	256	277	341	392
	Public Supply Non-Residential	Passive	22	24	22	24
		Metering	0	0	0	0
		Leak Detection	14	15	23	25
		Education Programs	0	0	12	13
		High Efficiency Plumbing Standards	0	0	8	17
		Subtotal	36	39	65	79
	Self Supply Residential	Passive	20	22	20	22
		Education Programs	0	0	3	3
		High Efficiency Plumbing Standards	0	0	3	6
		Subtotal	20	22	26	31
	Irrigated Agriculture	Irrigation Savings	126	158	234	435
	Total County Conservation Savings		438	495	665	936

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Oklahoma	Public Supply Residential	Passive	13,907	14,920	13,907	14,920
		Metering	0	0	69	74
		Leak Detection	1,047	1,124	2,529	2,714
		Conservation Rates	1,540	1,652	2,895	3,106
		Education Programs	1,805	1,936	3,008	3,227
		High Efficiency Plumbing Standards	0	0	1,921	3,807
		Subtotal	18,299	19,632	24,329	27,849
	Public Supply Non-Residential	Passive	4,089	4,387	4,089	4,387
		Metering	0	0	70	75
		Leak Detection	1,064	1,142	2,571	2,758
		Education Programs	0	0	1,834	1,968
		High Efficiency Plumbing Standards	0	0	1,477	3,169
		Subtotal	5,153	5,529	10,041	12,357
	Self Supply Residential	Passive	284	305	284	305
		Education Programs	0	0	32	34
		High Efficiency Plumbing Standards	0	0	39	78
		Subtotal	284	305	355	417
	Irrigated Agriculture	Irrigation Savings	302	302	736	921
	Total County Conservation Savings		24,038	25,768	35,460	41,543
Okmulgee	Public Supply Residential	Passive	792	934	792	934
		Metering	77	90	290	342
		Leak Detection	363	428	592	698
		Conservation Rates	133	157	347	409
		Education Programs	190	224	316	373
		High Efficiency Plumbing Standards	0	0	109	238
		Subtotal	1,555	1,834	2,445	2,994
	Public Supply Non-Residential	Passive	98	115	98	115
		Metering	13	15	48	57
		Leak Detection	60	71	98	115
		Education Programs	0	0	31	37
		High Efficiency Plumbing Standards	0	0	35	83
		Subtotal	170	201	310	408
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	59	59	551	551
	Total County Conservation Savings		1,784	2,094	3,306	3,952

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Osage	Public Supply Residential	Passive	757	859	757	859
		Metering	589	669	741	841
		Leak Detection	258	293	420	477
		Conservation Rates	34	39	185	210
		Education Programs	124	141	207	234
		High Efficiency Plumbing Standards	0	0	104	219
		Subtotal	1,762	2,000	2,414	2,840
	Public Supply Non-Residential	Passive	58	66	58	66
		Metering	102	116	128	145
		Leak Detection	45	51	73	83
		Education Programs	0	0	21	24
		High Efficiency Plumbing Standards	0	0	21	48
		Subtotal	205	232	301	366
	Self Supply Residential	Passive	132	150	132	150
		Education Programs	0	0	18	21
		High Efficiency Plumbing Standards	0	0	18	38
		Subtotal	132	150	169	209
	Irrigated Agriculture	Irrigation Savings	47	72	343	343
	Total County Conservation Savings		2,146	2,454	3,227	3,758
Ottawa	Public Supply Residential	Passive	520	621	520	621
		Metering	517	618	585	699
		Leak Detection	116	138	189	226
		Conservation Rates	0	0	6	7
		Education Programs	102	122	170	203
		High Efficiency Plumbing Standards	0	0	71	158
		Subtotal	1,255	1,499	1,541	1,914
	Public Supply Non-Residential	Passive	112	134	112	134
		Metering	383	458	434	518
		Leak Detection	86	103	140	167
		Education Programs	0	0	76	90
		High Efficiency Plumbing Standards	0	0	41	97
		Subtotal	582	695	802	1,007
	Self Supply Residential	Passive	143	170	143	170
		Education Programs	0	0	24	28
		High Efficiency Plumbing Standards	0	0	20	43
		Subtotal	143	170	186	242
	Irrigated Agriculture	Irrigation Savings	33	44	148	228
	Total County Conservation Savings		2,012	2,408	2,677	3,391

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Pawnee	Public Supply Residential	Passive	250	317	250	317
		Metering	26	32	70	88
		Leak Detection	75	95	122	155
		Conservation Rates	48	61	92	117
		Education Programs	66	84	110	139
		High Efficiency Plumbing Standards	0	0	34	81
		Subtotal	465	589	677	897
	Public Supply Non-Residential	Passive	35	44	35	44
		Metering	7	9	20	25
		Leak Detection	21	27	34	44
		Education Programs	0	0	19	24
		High Efficiency Plumbing Standards	0	0	12	32
		Subtotal	63	80	120	168
	Self Supply Residential	Passive	99	125	99	125
		Education Programs	0	0	22	28
		High Efficiency Plumbing Standards	0	0	13	32
		Subtotal	99	125	134	185
	Irrigated Agriculture	Irrigation Savings	10	18	108	144
	Total County Conservation Savings		636	812	1,039	1,393
Payne	Public Supply Residential	Passive	1,651	1,918	1,651	1,918
		Metering	0	0	0	0
		Leak Detection	283	328	461	535
		Conservation Rates	145	169	311	362
		Education Programs	63	73	104	121
		High Efficiency Plumbing Standards	0	0	225	489
		Subtotal	2,142	2,488	2,752	3,426
	Public Supply Non-Residential	Passive	343	399	343	399
		Metering	0	0	0	0
		Leak Detection	217	253	354	412
		Education Programs	0	0	48	56
		High Efficiency Plumbing Standards	0	0	124	288
		Subtotal	561	651	870	1,154
	Self Supply Residential	Passive	182	211	182	211
		Education Programs	0	0	6	7
		High Efficiency Plumbing Standards	0	0	25	54
		Subtotal	182	211	212	272
	Irrigated Agriculture	Irrigation Savings	75	76	10	18
	Total County Conservation Savings		2,958	3,426	3,844	4,869

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Pittsburg	Public Supply Residential	Passive	898	1,027	898	1,027
		Metering	0	0	74	84
		Leak Detection	196	224	319	365
		Conservation Rates	94	107	208	238
		Education Programs	142	162	236	270
		High Efficiency Plumbing Standards	0	0	124	262
		Subtotal	1,328	1,520	1,858	2,247
	Public Supply Non-Residential	Passive	162	185	162	185
		Metering	0	0	44	50
		Leak Detection	116	133	190	217
		Education Programs	0	0	84	96
		High Efficiency Plumbing Standards	0	0	59	134
		Subtotal	278	319	538	683
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	173	208	157	159
	Total County Conservation Savings		1,780	2,046	2,553	3,088
Pontotoc	Public Supply Residential	Passive	608	665	608	665
		Metering	0	0	53	58
		Leak Detection	0	0	52	57
		Conservation Rates	49	53	127	139
		Education Programs	113	124	189	207
		High Efficiency Plumbing Standards	0	0	84	170
		Subtotal	770	843	1,113	1,296
	Public Supply Non-Residential	Passive	178	195	178	195
		Metering	0	0	36	40
		Leak Detection	0	0	35	39
		Education Programs	0	0	77	85
		High Efficiency Plumbing Standards	0	0	64	141
		Subtotal	178	195	391	499
	Self Supply Residential	Passive	107	118	107	118
		Education Programs	0	0	18	19
		High Efficiency Plumbing Standards	0	0	15	30
		Subtotal	107	118	140	167
	Irrigated Agriculture	Irrigation Savings	177	305	609	730
	Total County Conservation Savings		1,233	1,461	2,252	2,692

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Pottawatomie	Public Supply Residential	Passive	959	1,115	959	1,115
		Metering	507	590	580	674
		Leak Detection	0	0	0	0
		Conservation Rates	0	0	0	0
		Education Programs	35	41	59	68
		High Efficiency Plumbing Standards	0	0	132	285
		Subtotal	1,502	1,746	1,729	2,142
	Public Supply Non-Residential	Passive	201	234	201	234
		Metering	454	528	518	603
		Leak Detection	0	0	0	0
		Education Programs	0	0	32	37
		High Efficiency Plumbing Standards	0	0	73	169
		Subtotal	655	761	824	1,042
	Self Supply Residential	Passive	414	482	414	482
		Education Programs	0	0	14	16
		High Efficiency Plumbing Standards	0	0	57	123
		Subtotal	414	482	485	621
	Irrigated Agriculture	Irrigation Savings	147	202	831	1,432
	Total County Conservation Savings		2,718	3,191	3,869	5,237
Pushmataha	Public Supply Residential	Passive	238	318	238	318
		Metering	62	84	80	107
		Leak Detection	29	39	48	64
		Conservation Rates	4	6	22	29
		Education Programs	11	15	19	25
		High Efficiency Plumbing Standards	0	0	32	81
		Subtotal	346	462	438	625
	Public Supply Non-Residential	Passive	33	44	33	44
		Metering	37	49	47	63
		Leak Detection	17	23	28	38
		Education Programs	0	0	7	9
		High Efficiency Plumbing Standards	0	0	12	32
		Subtotal	87	116	126	184
	Self Supply Residential	Passive	36	48	36	48
		Education Programs	0	0	1	2
		High Efficiency Plumbing Standards	0	0	5	12
		Subtotal	36	48	43	63
	Irrigated Agriculture	Irrigation Savings	46	46	496	682
	Total County Conservation Savings		514	673	1,103	1,554

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Roger Mills	Public Supply Residential	Passive	48	48	48	48
		Metering	6	6	15	15
		Leak Detection	16	16	26	26
		Conservation Rates	0	0	1	1
		Education Programs	8	8	14	14
		High Efficiency Plumbing Standards	0	0	7	12
		Subtotal	78	78	111	116
	Public Supply Non-Residential	Passive	8	8	8	8
		Metering	2	2	5	5
		Leak Detection	5	5	9	9
		Education Programs	0	0	3	3
		High Efficiency Plumbing Standards	0	0	3	5
		Subtotal	15	15	26	29
	Self Supply Residential	Passive	13	13	13	13
		Education Programs	0	0	2	2
		High Efficiency Plumbing Standards	0	0	2	3
		Subtotal	13	13	16	18
	Irrigated Agriculture	Irrigation Savings	391	393	260	264
	Total County Conservation Savings		497	499	414	427
Rogers	Public Supply Residential	Passive	1,603	1,998	1,603	1,998
		Metering	161	200	400	499
		Leak Detection	315	393	575	717
		Conservation Rates	106	132	345	430
		Education Programs	226	281	376	469
		High Efficiency Plumbing Standards	0	0	217	510
		Subtotal	2,410	3,005	3,517	4,624
	Public Supply Non-Residential	Passive	240	300	240	300
		Metering	57	71	141	176
		Leak Detection	111	139	203	253
		Education Programs	0	0	80	99
		High Efficiency Plumbing Standards	0	0	87	216
		Subtotal	408	509	751	1,044
	Self Supply Residential	Passive	115	144	115	144
		Education Programs	0	0	14	17
		High Efficiency Plumbing Standards	0	0	16	37
		Subtotal	115	144	145	198
	Irrigated Agriculture	Irrigation Savings	98	120	3,320	3,336
	Total County Conservation Savings		3,032	3,778	7,733	9,202

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Seminole	Public Supply Residential	Passive	373	405	373	405
		Metering	0	0	0	0
		Leak Detection	48	53	79	86
		Conservation Rates	14	16	43	46
		Education Programs	33	36	56	60
		High Efficiency Plumbing Standards	0	0	52	103
		Subtotal	469	509	601	700
	Public Supply Non-Residential	Passive	71	77	71	77
		Metering	0	0	0	0
		Leak Detection	54	59	88	95
		Education Programs	0	0	37	40
		High Efficiency Plumbing Standards	0	0	26	56
		Subtotal	125	136	222	269
	Self Supply Residential	Passive	73	80	73	80
		Education Programs	0	0	6	6
		High Efficiency Plumbing Standards	0	0	10	20
		Subtotal	73	80	89	106
	Irrigated Agriculture	Irrigation Savings	103	146	221	269
	Total County Conservation Savings		770	870	1,133	1,345
Sequoyah	Public Supply Residential	Passive	844	1,055	844	1,055
		Metering	375	468	520	649
		Leak Detection	247	308	402	502
		Conservation Rates	94	118	239	299
		Education Programs	183	229	306	382
		High Efficiency Plumbing Standards	0	0	115	269
		Subtotal	1,744	2,178	2,426	3,156
	Public Supply Non-Residential	Passive	94	118	94	118
		Metering	85	106	118	148
		Leak Detection	56	70	91	114
		Education Programs	0	0	42	52
		High Efficiency Plumbing Standards	0	0	34	85
		Subtotal	236	294	380	517
	Self Supply Residential	Passive	17	22	17	22
		Education Programs	0	0	3	4
		High Efficiency Plumbing Standards	0	0	2	5
		Subtotal	17	22	23	31
	Irrigated Agriculture	Irrigation Savings	97	111	538	764
	Total County Conservation Savings		2,093	2,605	3,366	4,468

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Stephens	Public Supply Residential	Passive	674	706	674	706
		Metering	0	0	28	30
		Leak Detection	189	198	308	323
		Conservation Rates	66	69	177	185
		Education Programs	149	156	249	261
		High Efficiency Plumbing Standards	0	0	94	180
		Subtotal	1,079	1,130	1,531	1,686
	Public Supply Non-Residential	Passive	142	149	142	149
		Metering	0	0	17	18
		Leak Detection	113	119	184	193
		Education Programs	0	0	89	93
		High Efficiency Plumbing Standards	0	0	51	108
		Subtotal	255	268	484	561
	Self Supply Residential	Passive	122	127	122	127
		Education Programs	0	0	23	24
		High Efficiency Plumbing Standards	0	0	17	33
		Subtotal	122	127	161	184
	Irrigated Agriculture	Irrigation Savings	198	309	402	462
	Total County Conservation Savings		1,654	1,834	2,579	2,893
Texas	Public Supply Residential	Passive	446	667	446	667
		Metering	0	0	0	0
		Leak Detection	146	219	239	357
		Conservation Rates	65	97	151	226
		Education Programs	17	25	28	42
		High Efficiency Plumbing Standards	0	0	58	170
		Subtotal	675	1,009	923	1,462
	Public Supply Non-Residential	Passive	73	109	73	109
		Metering	0	0	0	0
		Leak Detection	42	62	68	101
		Education Programs	0	0	5	7
		High Efficiency Plumbing Standards	0	0	26	79
		Subtotal	115	171	172	297
	Self Supply Residential	Passive	67	100	67	100
		Education Programs	0	0	2	3
		High Efficiency Plumbing Standards	0	0	9	25
		Subtotal	67	100	77	128
	Irrigated Agriculture	Irrigation Savings	10,803	11,017	1,002	1,564
	Total County Conservation Savings		11,659	12,296	2,174	3,450

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Tillman	Public Supply Residential	Passive	138	148	138	148
		Metering	15	16	36	39
		Leak Detection	15	16	38	41
		Conservation Rates	0	0	2	2
		Education Programs	32	34	53	57
		High Efficiency Plumbing Standards	0	0	19	38
		Subtotal	199	214	286	324
	Public Supply Non-Residential	Passive	20	22	20	22
		Metering	5	5	12	13
		Leak Detection	5	5	12	13
		Education Programs	0	0	10	11
		High Efficiency Plumbing Standards	0	0	7	16
		Subtotal	30	32	63	75
	Self Supply Residential	Passive	12	13	12	13
		Education Programs	0	0	2	3
		High Efficiency Plumbing Standards	0	0	2	3
		Subtotal	12	13	17	19
	Irrigated Agriculture	Irrigation Savings	1,533	1,594	43,868	44,736
	Total County Conservation Savings		1,775	1,854	44,233	45,155
Tulsa	Public Supply Residential	Passive	11,644	12,487	11,644	12,487
		Metering	0	0	0	0
		Leak Detection	0	0	0	0
		Conservation Rates	0	0	1,015	1,089
		Education Programs	616	660	1,026	1,100
		High Efficiency Plumbing Standards	0	0	1,607	3,186
		Subtotal	12,259	13,147	15,292	17,862
	Public Supply Non-Residential	Passive	3,314	3,554	3,314	3,554
		Metering	0	0	0	0
		Leak Detection	0	0	0	0
		Education Programs	0	0	428	459
		High Efficiency Plumbing Standards	0	0	1,197	2,567
		Subtotal	3,314	3,554	4,939	6,580
	Self Supply Residential	Passive	181	194	181	194
		Education Programs	0	0	9	9
		High Efficiency Plumbing Standards	0	0	25	49
		Subtotal	181	194	214	253
	Irrigated Agriculture	Irrigation Savings	445	487	2,444	2,541
	Total County Conservation Savings		16,199	17,382	22,889	27,237

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Wagoner	Public Supply Residential	Passive	1,360	1,661	1,360	1,661
		Metering	119	146	298	364
		Leak Detection	305	373	497	608
		Conservation Rates	61	75	240	293
		Education Programs	83	101	138	169
		High Efficiency Plumbing Standards	0	0	185	424
		Subtotal	1,928	2,355	2,719	3,519
	Public Supply Non-Residential	Passive	68	83	68	83
		Metering	16	19	39	48
		Leak Detection	40	49	66	80
		Education Programs	0	0	11	13
		High Efficiency Plumbing Standards	0	0	25	60
		Subtotal	124	152	209	285
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	466	466	531	581
	Total County Conservation Savings		2,519	2,973	3,459	4,386
Washington	Public Supply Residential	Passive	946	987	946	987
		Metering	75	79	233	243
		Leak Detection	269	280	438	457
		Conservation Rates	158	164	315	329
		Education Programs	26	27	43	45
		High Efficiency Plumbing Standards	0	0	132	252
		Subtotal	1,474	1,538	2,109	2,313
	Public Supply Non-Residential	Passive	183	191	183	191
		Metering	44	46	136	142
		Leak Detection	157	164	256	267
		Education Programs	0	0	15	16
		High Efficiency Plumbing Standards	0	0	66	138
		Subtotal	384	400	656	753
	Self Supply Residential	Passive	0	0	0	0
		Education Programs	0	0	0	0
		High Efficiency Plumbing Standards	0	0	0	0
		Subtotal	0	0	0	0
	Irrigated Agriculture	Irrigation Savings	48	73	1,326	1,326
	Total County Conservation Savings		1,906	2,011	4,091	4,392

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Washita	Public Supply Residential	Passive	178	188	178	188
		Metering	32	34	47	50
		Leak Detection	0	0	11	12
		Conservation Rates	0	0	12	13
		Education Programs	12	12	20	21
		High Efficiency Plumbing Standards	0	0	25	48
		Subtotal	222	234	293	331
	Public Supply Non-Residential	Passive	22	23	22	23
		Metering	19	20	28	30
		Leak Detection	0	0	7	7
		Education Programs	0	0	7	7
		High Efficiency Plumbing Standards	0	0	8	17
		Subtotal	41	43	71	84
	Self Supply Residential	Passive	41	44	41	44
		Education Programs	0	0	2	3
		High Efficiency Plumbing Standards	0	0	6	11
		Subtotal	41	44	49	57
	Irrigated Agriculture	Irrigation Savings	310	346	218	328
	Total County Conservation Savings		613	667	632	801
Woods	Public Supply Residential	Passive	146	153	146	153
		Metering	493	514	548	571
		Leak Detection	93	97	152	159
		Conservation Rates	0	0	12	13
		Education Programs	59	61	98	102
		High Efficiency Plumbing Standards	0	0	20	39
		Subtotal	791	825	976	1,036
	Public Supply Non-Residential	Passive	29	30	29	30
		Metering	87	91	97	101
		Leak Detection	17	17	27	28
		Education Programs	0	0	10	11
		High Efficiency Plumbing Standards	0	0	11	22
		Subtotal	133	139	174	192
	Self Supply Residential	Passive	23	24	23	24
		Education Programs	0	0	8	8
		High Efficiency Plumbing Standards	0	0	3	6
		Subtotal	23	24	33	37
	Irrigated Agriculture	Irrigation Savings	210	247	830	929
	Total County Conservation Savings		1,157	1,234	2,013	2,194

County	Sector	Conservation Activity	Scenario I Savings (AFY) 2030	Scenario I Savings (AFY) 2060	Scenario II Savings (AFY) 2030	Scenario II Savings (AFY) 2060
Woodward	Public Supply Residential	Passive	308	327	308	327
		Metering	0	0	0	0
		Leak Detection	0	0	0	0
		Conservation Rates	79	84	157	167
		Education Programs	23	24	38	41
		High Efficiency Plumbing Standards	0	0	43	83
		Subtotal	409	435	546	618
	Public Supply Non-Residential	Passive	89	95	89	95
		Metering	0	0	0	0
		Leak Detection	0	0	0	0
		Education Programs	0	0	13	14
		High Efficiency Plumbing Standards	0	0	32	69
		Subtotal	89	95	135	178
	Self Supply Residential	Passive	67	72	67	72
		Education Programs	0	0	5	5
		High Efficiency Plumbing Standards	0	0	9	18
		Subtotal	67	72	81	95
	Irrigated Agriculture	Irrigation Savings	423	423	1,364	1,598
	Total County Conservation Savings		989	1,025	2,126	2,489

Appendix B
County Water Demands in AFY for Baseline (No Conservation), Conservation Scenario I and Conservation Scenario II

Table B1: Public Supplied M&I and Self Supplied Residential in AFY

County	Baseline Demands		Scenario I Demands		Scenario II Demands	
	2030	2060	2030	2060	2030	2060
Adair	3,535	4,878	2,511	3,465	2,250	2,995
Alfalfa	997	1,031	857	886	803	813
Atoka	4,435	5,837	3,793	4,991	3,529	4,568
Beaver	1,114	1,169	999	1,048	964	994
Beckham	5,941	7,403	5,315	6,622	5,057	6,198
Blaine	3,142	3,922	2,475	3,090	2,301	2,819
Bryan	10,244	12,951	9,026	11,412	8,405	10,430
Caddo	5,121	5,570	4,295	4,671	3,992	4,248
Canadian	18,000	20,884	13,290	15,419	11,992	13,531
Carter	10,073	11,672	8,614	9,981	7,948	8,990
Cherokee	9,762	13,096	7,992	10,721	7,134	9,319
Choctaw	2,008	2,156	1,586	1,703	1,428	1,481
Cimarron	1,074	1,136	974	1,029	923	966
Cleveland	44,312	48,785	37,413	41,190	35,112	37,750
Coal	1,004	1,412	827	1,164	771	1,056
Comanche	18,934	20,613	12,657	13,779	11,199	11,729
Cotton	821	869	552	584	474	482
Craig	2,824	3,643	2,570	3,316	2,350	2,999
Creek	10,002	11,412	7,991	9,117	7,097	7,853
Custer	6,340	6,948	5,102	5,591	4,517	4,841
Delaware	6,676	9,147	5,060	6,932	4,450	5,893
Dewey	1,403	1,465	1,257	1,313	1,142	1,179
Ellis	991	991	867	867	802	791
Garfield	13,247	14,052	11,254	11,938	10,509	10,923
Garvin	5,503	5,829	4,609	4,882	4,151	4,303
Grady	7,210	8,279	5,726	6,575	5,096	5,664
Grant	833	880	695	734	622	643
Greer	1,049	1,103	881	926	820	843
Harmon	821	894	711	774	652	700
Harper	1,240	1,277	1,048	1,079	962	979
Haskell	2,241	3,049	1,806	2,458	1,657	2,183
Hughes	2,284	3,005	1,581	2,081	1,352	1,716
Jackson	5,254	5,726	4,339	4,729	3,869	4,112
Jefferson	819	879	528	567	459	474
Johnston	2,211	2,943	1,591	2,118	1,398	1,808
Kay	8,470	9,071	5,934	6,356	5,178	5,365
Kingfisher	4,212	5,460	3,677	4,766	3,402	4,334
Kiowa	1,287	1,351	1,018	1,069	907	923
Latimer	2,717	3,212	2,305	2,724	2,098	2,434
Le Flore	8,134	9,648	6,133	7,275	5,367	6,175
Lincoln	4,367	5,286	3,375	4,085	3,000	3,506
Logan	7,664	9,748	5,806	7,386	5,215	6,479
Love	5,534	6,592	4,066	4,844	3,606	4,193
Major	1,222	1,271	964	1,002	882	894

Table B1: Public Supplied M&I and Self Supplied Residential in AFY

County	Baseline Demands		Scenario I Demands		Scenario II Demands	
	2030	2060	2030	2060	2030	2060
Marshall	4,422	6,722	3,666	5,573	3,309	4,909
Mayes	6,526	8,200	5,069	6,369	4,440	5,402
McClain	6,478	8,831	5,243	7,147	4,766	6,338
McCurtain	5,445	5,926	4,067	4,426	3,647	3,851
McIntosh	3,066	4,202	2,301	3,153	2,041	2,698
Murray	3,216	4,059	2,638	3,329	2,362	2,915
Muskogee	11,604	12,480	9,448	10,162	8,569	8,944
Noble	1,953	2,104	1,629	1,755	1,440	1,507
Nowata	1,477	1,995	1,038	1,402	887	1,148
Okfuskee	1,597	1,725	1,285	1,387	1,165	1,224
Oklahoma	137,812	147,856	114,076	122,390	103,087	107,234
Okmulgee	12,415	14,645	10,690	12,610	9,660	11,243
Osage	9,997	11,345	7,899	8,964	7,113	7,930
Ottawa	6,711	8,016	4,732	5,652	4,182	4,853
Pawnee	3,555	4,508	2,929	3,714	2,623	3,258
Payne	15,446	17,946	12,563	14,596	11,612	13,095
Pittsburg	9,150	10,471	7,543	8,632	6,754	7,541
Pontotoc	7,211	7,895	6,155	6,739	5,567	5,933
Pottawatomie	8,297	9,647	5,726	6,658	5,259	5,841
Pushmataha	1,483	1,983	1,015	1,357	876	1,112
Roger Mills	730	730	624	624	576	567
Rogers	16,952	21,134	14,018	17,476	12,539	15,268
Seminole	3,240	3,519	2,573	2,795	2,328	2,444
Sequoyah	9,012	11,256	7,015	8,762	6,184	7,552
Stephens	9,717	10,183	8,261	8,657	7,540	7,752
Texas	6,058	9,056	5,202	7,776	4,886	7,169
Tillman	1,501	1,610	1,259	1,351	1,135	1,191
Tulsa	122,528	131,403	106,774	114,508	102,082	106,708
Wagoner	10,137	12,383	8,085	9,875	7,209	8,578
Washington	12,486	13,021	10,627	11,083	9,721	9,955
Washita	1,331	1,405	1,027	1,084	917	933
Woods	3,582	3,737	2,636	2,749	2,399	2,471
Woodward	6,954	7,393	6,388	6,791	6,192	6,502

Table B2: Agriculture in AFY

County	Baseline Demands		Scenario I Demands		Scenario II Demands	
	2030	2060	2030	2060	2030	2060
Adair	1,518	2,203	1,434	2,080	1,081	1,569
Alfalfa	5,940	7,285	5,610	6,881	4,420	5,421
Atoka	1,666	2,339	1,573	2,209	1,128	1,585
Beaver	34,538	37,383	32,715	35,409	24,303	26,305
Beckham	8,718	8,718	8,234	8,234	7,537	7,537
Blaine	6,517	6,517	6,155	6,155	5,831	5,831
Bryan	17,536	18,178	16,562	17,169	15,808	16,387
Caddo	37,078	45,228	35,027	42,726	31,549	38,484
Canadian	6,818	7,482	6,443	7,071	5,633	6,181
Carter	2,812	2,918	2,656	2,756	2,473	2,566
Cherokee	1,644	1,859	1,553	1,755	1,176	1,330
Choctaw	1,154	1,597	1,090	1,508	812	1,124
Cimarron	73,517	90,606	69,503	85,658	55,848	68,830
Cleveland	1,571	2,178	1,488	2,063	1,403	1,946
Coal	643	650	607	614	474	480
Comanche	3,089	3,688	2,918	3,483	2,495	2,979
Cotton	793	1,110	750	1,050	737	1,033
Craig	1,128	2,599	1,065	2,455	834	1,922
Creek	433	560	409	529	356	460
Custer	4,957	5,232	4,691	4,951	4,179	4,410
Delaware	949	949	897	897	682	682
Dewey	4,752	4,752	4,488	4,488	3,823	3,823
Ellis	27,870	35,263	26,343	33,331	16,691	21,118
Garfield	6,029	6,029	5,956	5,956	4,886	4,886
Garvin	2,298	3,734	2,186	3,552	1,962	3,189
Grady	11,291	11,291	10,664	10,664	9,634	9,634
Grant	1,801	1,801	1,701	1,701	1,461	1,461
Greer	10,445	17,016	9,892	16,116	8,254	13,447
Harmon	27,927	30,137	23,734	25,611	22,282	24,045
Harper	11,759	13,813	11,152	13,100	7,048	8,278
Haskell	3,006	3,633	2,839	3,431	2,097	2,533
Hughes	5,360	8,474	5,063	8,003	3,930	6,212
Jackson	105,813	111,960	84,866	89,796	83,255	88,090
Jefferson	427	523	407	498	396	485
Johnston	2,344	3,662	2,234	3,491	1,876	2,932
Kay	4,690	4,690	4,435	4,435	4,238	4,238
Kingfisher	8,716	9,902	8,232	9,351	6,729	7,643
Kiowa	4,813	5,190	4,173	4,499	3,508	3,782
Latimer	1,846	3,344	1,744	3,158	1,278	2,315
Le Flore	9,985	9,985	9,788	9,788	9,009	9,009
Lincoln	3,575	3,575	3,376	3,376	2,533	2,533
Logan	1,991	1,991	1,880	1,880	1,519	1,519
Love	3,695	5,133	3,490	4,848	3,041	4,223
Major	13,122	13,254	12,396	12,522	10,342	10,447

Table B2: Agriculture in AFY

County	Baseline Demands		Scenario I Demands		Scenario II Demands	
	2030	2060	2030	2060	2030	2060
Marshall	4,952	5,397	4,698	5,119	4,621	5,036
Mayes	1,411	1,735	1,333	1,639	1,002	1,231
McClain	2,969	3,120	2,806	2,949	2,662	2,798
McCurtain	1,756	3,105	1,756	3,105	1,391	2,460
McIntosh	685	690	647	652	548	552
Murray	332	765	314	722	292	674
Muskogee	8,882	8,882	8,416	8,416	7,284	7,284
Noble	1,223	1,223	1,155	1,155	865	865
Nowata	616	1,148	581	1,084	382	712
Okfuskee	2,267	2,836	2,141	2,679	1,531	1,916
Oklahoma	5,537	5,537	5,235	5,235	4,986	4,986
Okmulgee	1,250	1,250	1,191	1,191	907	907
Osage	843	1,302	797	1,229	696	1,073
Ottawa	598	795	565	751	490	652
Pawnee	179	317	169	299	169	299
Payne	1,344	1,360	1,269	1,284	1,187	1,201
Pittsburg	3,299	3,958	3,126	3,751	2,690	3,228
Pontotoc	3,284	5,657	3,107	5,352	2,453	4,225
Pottawatomie	2,639	3,628	2,492	3,426	2,143	2,946
Pushmataha	824	836	778	790	563	572
Roger Mills	9,296	9,342	8,905	8,949	5,976	6,006
Rogers	1,769	2,160	1,671	2,040	1,549	1,890
Seminole	1,847	2,624	1,744	2,478	1,309	1,860
Sequoyah	2,465	2,832	2,369	2,721	2,063	2,370
Stephens	3,564	5,564	3,366	5,255	2,563	4,000
Texas	202,385	206,393	191,583	195,377	158,518	161,657
Tillman	18,661	19,408	17,128	17,813	16,217	16,866
Tulsa	8,012	8,775	7,567	8,287	7,481	8,193
Wagoner	8,392	8,392	7,926	7,926	7,065	7,065
Washington	867	1,306	819	1,234	649	978
Washita	5,571	6,234	5,262	5,888	4,741	5,305
Woods	3,787	4,439	3,577	4,192	2,423	2,840
Woodward	8,026	8,026	7,602	7,602	5,370	5,370

Table B3: Combined Public Supplied M&I, Self Supplied Residential, and Agriculture in AFY

County	Baseline Demands		Scenario I Demands		Scenario II Demands	
	2030	2060	2030	2060	2030	2060
Adair	5,054	7,081	3,945	5,545	3,331	4,564
Alfalfa	6,938	8,317	6,467	7,767	5,223	6,234
Atoka	6,101	8,176	5,366	7,201	4,657	6,153
Beaver	35,652	38,551	33,714	36,458	25,267	27,299
Beckham	14,659	16,121	13,548	14,856	12,594	13,735
Blaine	9,658	10,439	8,630	9,244	8,132	8,650
Bryan	27,781	31,130	25,588	28,580	24,213	26,817
Caddo	42,198	50,797	39,321	47,397	35,541	42,733
Canadian	24,818	28,366	19,733	22,490	17,624	19,712
Carter	12,885	14,590	11,270	12,737	10,421	11,556
Cherokee	11,406	14,955	9,544	12,476	8,310	10,649
Choctaw	3,162	3,753	2,676	3,211	2,240	2,605
Cimarron	74,591	91,742	70,476	86,688	56,771	69,796
Cleveland	45,883	50,964	38,901	43,253	36,515	39,696
Coal	1,646	2,062	1,434	1,778	1,245	1,536
Comanche	22,024	24,301	15,575	17,262	13,694	14,708
Cotton	1,614	1,979	1,301	1,634	1,211	1,515
Craig	3,952	6,242	3,635	5,771	3,184	4,922
Creek	10,435	11,971	8,400	9,646	7,454	8,314
Custer	11,296	12,180	9,793	10,543	8,695	9,252
Delaware	7,626	10,097	5,956	7,829	5,132	6,575
Dewey	6,154	6,217	5,744	5,800	4,965	5,002
Ellis	28,861	36,254	27,209	34,198	17,493	21,909
Garfield	19,276	20,082	17,210	17,894	15,395	15,808
Garvin	7,801	9,564	6,795	8,434	6,113	7,491
Grady	18,501	19,570	16,391	17,240	14,730	15,299
Grant	2,634	2,681	2,396	2,435	2,083	2,104
Greer	11,494	18,119	10,773	17,042	9,075	14,291
Harmon	28,749	31,030	24,445	26,386	22,934	24,745
Harper	13,000	15,089	12,201	14,179	8,010	9,257
Haskell	5,248	6,682	4,646	5,888	3,753	4,716
Hughes	7,644	11,479	6,644	10,084	5,282	7,928
Jackson	111,067	117,685	89,206	94,525	87,123	92,203
Jefferson	1,246	1,402	935	1,065	855	959
Johnston	4,555	6,605	3,825	5,609	3,274	4,740
Kay	13,160	13,761	10,370	10,791	9,417	9,604
Kingfisher	12,929	15,362	11,909	14,118	10,130	11,977
Kiowa	6,101	6,541	5,191	5,568	4,415	4,704
Latimer	4,564	6,555	4,049	5,882	3,376	4,749
Le Flore	18,119	19,633	15,921	17,062	14,375	15,183
Lincoln	7,942	8,861	6,752	7,462	5,533	6,039
Logan	9,654	11,739	7,687	9,266	6,734	7,999
Love	9,229	11,725	7,556	9,691	6,646	8,416
Major	14,344	14,526	13,360	13,524	11,224	11,340

Table B3: Combined Public Supplied M&I, Self Supplied Residential, and Agriculture in AFY

County	Baseline Demands		Scenario I Demands		Scenario II Demands	
	2030	2060	2030	2060	2030	2060
Marshall	9,374	12,118	8,364	10,693	7,930	9,945
Mayes	7,938	9,935	6,402	8,008	5,441	6,634
McClain	9,447	11,951	8,049	10,096	7,428	9,136
McCurtain	7,201	9,031	5,822	7,530	5,039	6,311
McIntosh	3,752	4,892	2,948	3,805	2,589	3,250
Murray	3,548	4,824	2,951	4,052	2,654	3,589
Muskogee	20,486	21,362	17,865	18,578	15,853	16,227
Noble	3,176	3,326	2,784	2,909	2,305	2,372
Nowata	2,093	3,143	1,620	2,486	1,270	1,861
Okfuskee	3,864	4,561	3,425	4,066	2,696	3,140
Oklahoma	143,349	153,393	119,311	127,625	108,073	112,220
Okmulgee	13,666	15,895	11,882	13,801	10,568	12,150
Osage	10,841	12,647	8,695	10,193	7,809	9,004
Ottawa	7,309	8,811	5,297	6,403	4,672	5,505
Pawnee	3,734	4,825	3,098	4,014	2,793	3,558
Payne	16,790	19,306	13,832	15,880	12,799	14,296
Pittsburg	12,449	14,429	10,669	12,383	9,444	10,769
Pontotoc	10,495	13,552	9,262	12,091	8,020	10,158
Pottawatomie	10,936	13,275	8,218	10,084	7,402	8,787
Pushmataha	2,307	2,819	1,793	2,147	1,439	1,684
Roger Mills	10,026	10,072	9,529	9,573	6,553	6,572
Rogers	18,721	23,293	15,689	19,515	14,088	17,158
Seminole	5,087	6,143	4,317	5,273	3,636	4,304
Sequoyah	11,477	14,088	9,383	11,483	8,247	9,922
Stephens	13,281	15,747	11,627	13,912	10,103	11,752
Texas	208,443	215,449	196,784	203,153	163,403	168,826
Tillman	20,162	21,018	18,387	19,164	17,353	18,058
Tulsa	130,539	140,178	114,340	122,795	109,563	114,901
Wagoner	18,529	20,774	16,010	17,801	14,275	15,644
Washington	13,353	14,328	11,447	12,317	10,370	10,933
Washita	6,902	7,639	6,289	6,972	5,658	6,238
Woods	7,370	8,175	6,213	6,941	4,822	5,311
Woodward	14,980	15,419	13,990	14,394	11,563	11,873

Appendix C
Selected Climate Change Scenario Data

Table C1: Historical Average Weather Variables by County and Month

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Adair	Precip*	2.2	2.5	3.8	4.4	5.7	4.7	3.6	3.3	4.4	3.9	3.8
	Temp**	48.2	53.4	61.8	72	78.7	85.9	91.6	91.6	84	73.8	60.7
Alfalfa	Precip	0.9	1.1	2.3	2.7	4.2	4.4	3.2	3.1	3	2.6	1.7
	Temp	46.5	52.1	61.1	71.9	80.6	90.1	95.6	94.6	85.8	74.7	59.5
Atoka	Precip	2	2.4	3.5	4.4	5.5	4.5	3.2	2.7	4.5	3.8	3.2
	Temp	51.2	56.5	64.6	74	80.6	88.1	93.8	94.2	86.5	76.4	63.5
Beaver	Precip	0.5	0.8	1.6	1.7	3.3	3.4	2.7	2.6	2	1.6	1
	Temp	47.6	52.5	60.5	71.3	79.5	88.7	94.1	93	84.6	73.9	59.3
Beckham	Precip	0.8	1.1	1.8	2.2	4.5	3.8	2.3	2.5	2.8	2.6	1.4
	Temp	50.3	55.5	64.1	74.2	82.1	90.5	95.7	94.7	86.4	75.7	61.7
Blaine	Precip	0.9	1.2	2.2	2.6	4.6	4.2	2.7	2.9	3.1	2.5	1.7
	Temp	48.1	53.4	62.3	72.7	80.9	89.8	95.4	94.6	86.1	75.1	60.4
Bryan	Precip	1.9	2.3	3.4	4.1	5.3	4.5	2.9	2.6	4.4	4	2.9
	Temp	51.8	56.9	65	74.2	80.9	88.5	93.9	94.2	86.6	76.6	63.8
Caddo	Precip	1.1	1.4	2.3	2.9	5.1	4.1	2.6	2.8	3.4	3.2	1.8
	Temp	50	55.5	64.1	74	81.3	89.1	94.6	94.1	86.2	75.7	62.1
Canadian	Precip	0.9	1.2	2.2	2.6	4.8	4.2	2.5	2.8	3.2	2.8	1.7
	Temp	48.2	53.4	62.1	72.2	80.1	88.5	94.1	93.5	85.1	74.3	60.2
Carter	Precip	1.5	1.9	2.8	3.4	5.3	4.1	2.7	2.6	4	3.7	2.3
	Temp	51.6	56.9	65.2	74.6	81.4	88.9	94.5	94.7	86.8	76.6	63.4
Cherokee	Precip	2.2	2.5	3.8	4.4	5.7	4.7	3.6	3.3	4.4	3.9	3.8
	Temp	48.2	53.4	61.8	72	78.7	85.9	91.6	91.6	84	73.8	60.7
Choctaw	Precip	2.7	3.2	4	4.5	5.6	4.2	3.6	2.9	4.4	4.2	4
	Temp	53.6	58.6	66.6	75.3	82	89	94	94.6	87.4	77.6	65
Cimarron	Precip	0.4	0.5	1.1	1.3	2.7	2.7	2.7	2.5	1.7	1.1	0.7
	Temp	48.7	53.1	60.6	70.9	79.5	89.1	93.7	91.7	84	73.6	59
Cleveland	Precip	1.4	1.8	2.8	3.4	5.5	4.4	3	2.8	4	3.6	2.4
	Temp	49.8	55.3	63.8	73.6	80.4	88.1	93.9	93.9	85.8	75.5	62.1
Coal	Precip	2	2.4	3.5	4.4	5.5	4.5	3.2	2.7	4.5	3.8	3.2
	Temp	51.2	56.5	64.6	74	80.6	88.1	93.8	94.2	86.5	76.4	63.5
Comanche	Precip	1.1	1.4	2.2	2.6	5.1	4	2.4	2.6	3.3	3.1	1.8
	Temp	51	56.2	64.7	74.4	81.8	89.9	95.4	95.1	86.8	76.3	62.6

Table C1: Historical Average Weather Variables by County and Month

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Cotton	Precip	1.1	1.4	2.2	2.6	5.1	4	2.4	2.6	3.3	3.1	1.8
	Temp	51	56.2	64.7	74.4	81.8	89.9	95.4	95.1	86.8	76.3	62.6
Craig	Precip	1.9	2.1	3.4	4.1	5.6	4.7	3.4	3.3	4.4	3.8	3.4
	Temp	47.3	52.8	61.6	72	79	86.4	92.1	92.2	84.3	74	60.5
Creek	Precip	1.6	2	3.2	3.9	5.4	4.5	3.3	2.8	4.2	3.6	2.9
	Temp	48.2	53.8	62.4	72.7	79.6	87.3	93.1	93.1	85	74.9	61.4
Custer	Precip	0.9	1.1	2	2.4	4.6	3.9	2.4	2.7	2.9	2.6	1.4
	Temp	49.7	54.9	63.4	73.6	81.5	90.2	95.6	94.8	86.3	75.4	61.3
Delaware	Precip	1.8	2	3.3	3.9	5.5	4.8	3.4	3.3	4.5	3.7	3.4
	Temp	46.6	52.1	61	71.7	78.7	86.2	91.7	91.8	83.9	73.4	60
Dewey	Precip	0.7	1	1.9	2.3	4.5	3.8	2.3	2.7	2.7	2.3	1.4
	Temp	48.1	53.1	61.5	71.9	79.9	88.7	94.4	93.4	84.9	74	59.8
Ellis	Precip	0.6	0.9	1.6	1.9	3.7	3.5	2.4	2.5	2	1.8	1.1
	Temp	47.4	52.2	60.3	71.1	79	87.8	93.4	92.4	84	73.4	59.1
Garfield	Precip	1	1.4	2.5	2.9	5	4.4	3.1	3	3.7	2.9	2
	Temp	47.7	53.1	62	72.6	80.5	89	94.7	94.3	85.8	74.9	60.4
Garvin	Precip	1.5	1.9	2.8	3.4	5.3	4.1	2.7	2.6	4	3.7	2.3
	Temp	51.6	56.9	65.2	74.6	81.4	88.9	94.5	94.7	86.8	76.6	63.4
Grady	Precip	1.1	1.4	2.3	2.9	5.1	4.1	2.6	2.8	3.4	3.2	1.8
	Temp	50	55.5	64.1	74	81.3	89.1	94.6	94.1	86.2	75.7	62.1
Grant	Precip	0.9	1.1	2.3	2.7	4.2	4.4	3.2	3.1	3	2.6	1.7
	Temp	46.5	52.1	61.1	71.9	80.6	90.1	95.6	94.6	85.8	74.7	59.5
Greer	Precip	0.8	1.1	1.7	2.1	4.4	3.8	2.3	2.5	2.8	2.6	1.3
	Temp	52	57.2	66.1	76.2	83.7	91.9	96.9	95.9	87.7	77.2	63.2
Harmon	Precip	0.7	1	1.4	2.1	3.7	3.6	2.2	2.4	2.8	2.4	1.2
	Temp	53.3	58.4	67.2	77.2	84.8	93	97.6	96.6	88.3	78	64.1
Harper	Precip	0.6	0.8	1.7	2	3.6	3.6	2.7	2.8	2.2	1.7	1.1
	Temp	48	53.2	61.6	72.4	80.6	89.7	95.2	94	85.6	74.9	59.9
Haskell	Precip	2.4	2.7	3.8	4.4	5.7	4.4	3.7	2.9	4.3	3.9	4
	Temp	49.7	54.9	63.3	73.4	80.1	87.4	93	92.9	85.4	75.3	62.2
Hughes	Precip	1.9	2.3	3.5	4.2	5.6	4.4	3.5	2.9	4.5	3.8	3.2
	Temp	50.1	55.5	64	73.7	80.3	87.8	93.6	93.7	85.9	75.8	62.6

Table C1: Historical Average Weather Variables by County and Month

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Jackson	Precip	0.9	1.2	1.8	2.2	4.5	3.8	2.3	2.5	2.9	2.7	1.4
	Temp	51.4	56.6	65.3	75.2	83.1	91.6	96.7	95.6	87.3	76.7	62.8
Jefferson	Precip	1.3	1.7	2.3	2.9	4.7	3.8	2.4	2.4	3.4	3.1	1.9
	Temp	54.2	59.3	67.7	76.8	83.8	91.3	96.9	96.7	88.8	78.6	65.4
Johnston	Precip	1.8	2.2	3.1	3.8	5.1	4.3	2.6	2.4	4.1	3.8	2.6
	Temp	52.7	57.7	65.8	74.9	81.7	89.2	94.6	94.9	87.3	77.2	64.3
Kay	Precip	1	1.4	2.6	3.2	4.8	4.6	3.5	3.2	3.8	2.9	2.1
	Temp	46.2	52	61	71.9	79.7	88.2	93.9	93.4	84.9	74.2	59.5
Kingfisher	Precip	0.9	1.2	2.2	2.6	4.6	4.2	2.7	2.9	3.1	2.5	1.7
	Temp	48.1	53.4	62.3	72.7	80.9	89.8	95.4	94.6	86.1	75.1	60.4
Kiowa	Precip	0.8	1.1	1.8	2.2	4.5	3.8	2.3	2.5	2.8	2.6	1.4
	Temp	50.3	55.5	64.1	74.2	82.1	90.5	95.7	94.7	86.4	75.7	61.7
Latimer	Precip	2.7	3	4.2	4.7	6	4.3	4	3	4.4	4	4.3
	Temp	51.3	56.3	64.5	74.2	80.8	88	93.5	93.5	86	76	63.3
Le Flore	Precip	2.7	3	4.2	4.7	6	4.3	4	3	4.4	4	4.3
	Temp	51.3	56.3	64.5	74.2	80.8	88	93.5	93.5	86	76	63.3
Lincoln	Precip	1.3	1.8	2.8	3.5	5.4	4.4	3.2	2.8	4.1	3.4	2.5
	Temp	49.3	54.8	63.4	73.5	80.2	87.9	93.8	93.8	85.7	75.4	61.9
Logan	Precip	1	1.4	2.5	2.9	5	4.4	3.1	3	3.7	2.9	2
	Temp	47.7	53.1	62	72.6	80.5	89	94.7	94.3	85.8	74.9	60.4
Love	Precip	1.8	2.2	3.1	3.8	5.1	4.3	2.6	2.4	4.1	3.8	2.6
	Temp	52.7	57.7	65.8	74.9	81.7	89.2	94.6	94.9	87.3	77.2	64.3
Major	Precip	0.9	1.2	2.2	2.6	4.6	4.2	2.7	2.9	3.1	2.5	1.7
	Temp	48.1	53.4	62.3	72.7	80.9	89.8	95.4	94.6	86.1	75.1	60.4
Marshall	Precip	1.8	2.2	3.1	3.8	5.1	4.3	2.6	2.4	4.1	3.8	2.6
	Temp	52.7	57.7	65.8	74.9	81.7	89.2	94.6	94.9	87.3	77.2	64.3
Mayes	Precip	1.9	2.1	3.4	4.1	5.6	4.7	3.4	3.3	4.4	3.8	3.4
	Temp	47.3	52.8	61.6	72	79	86.4	92.1	92.2	84.3	74	60.5
McClain	Precip	1.3	1.6	2.6	3.3	5.5	4.2	2.9	2.7	3.9	3.3	2.1
	Temp	50	55.5	64	73.9	80.8	88.4	94.3	94.2	86.1	75.7	62.2
McCurtain	Precip	3.1	3.6	4.3	4.6	5.4	4	3.7	2.5	4.1	4.2	4.4
	Temp	53.9	58.8	66.7	75.2	82	89	93.6	94.2	87.3	77.6	65.2

Table C1: Historical Average Weather Variables by County and Month

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
McIntosh	Precip	1.9	2.3	3.5	4.2	5.6	4.4	3.5	2.9	4.5	3.8	3.2
	Temp	50.1	55.5	64	73.7	80.3	87.8	93.6	93.7	85.9	75.8	62.6
Murray	Precip	1.5	1.9	2.8	3.4	5.3	4.1	2.7	2.6	4	3.7	2.3
	Temp	51.6	56.9	65.2	74.6	81.4	88.9	94.5	94.7	86.8	76.6	63.4
Muskogee	Precip	2.1	2.4	3.6	4.3	5.6	4.4	3.5	2.9	4.5	3.9	3.5
	Temp	48.7	54	62.6	72.9	79.8	87.4	93.3	93.3	85.5	75.1	61.8
Noble	Precip	1.2	1.6	2.8	3.3	5.2	4.4	3.3	3	4	3.1	2.2
	Temp	47.8	53.4	62.1	72.8	79.9	87.8	93.7	93.6	85.3	74.9	60.9
Nowata	Precip	1.5	1.8	3.2	3.8	5.4	4.9	3.3	3.2	4.4	3.5	3
	Temp	46.3	52.2	61.2	71.8	79.1	87.1	92.9	92.9	84.7	74	60.2
Okfuskee	Precip	1.4	1.8	2.8	3.5	5.4	4.5	3	2.8	4.1	3.5	2.4
	Temp	49.4	54.9	63.4	73.3	80.1	87.8	93.6	93.6	85.5	75.2	61.8
Oklahoma	Precip	1.4	1.8	2.8	3.5	5.4	4.5	3	2.8	4.1	3.5	2.4
	Temp	49.4	54.9	63.4	73.3	80.1	87.8	93.6	93.6	85.5	75.2	61.8
Okmulgee	Precip	1.9	2.3	3.5	4.2	5.6	4.4	3.5	2.9	4.5	3.8	3.2
	Temp	50.1	55.5	64	73.7	80.3	87.8	93.6	93.7	85.9	75.8	62.6
Osage	Precip	1.3	1.7	3	3.7	5.4	4.7	3.4	3.1	4.2	3.2	2.5
	Temp	47.2	53	61.9	72.6	79.5	87.2	93.1	93.1	84.8	74.3	60.5
Ottawa	Precip	1.8	2	3.3	3.9	5.5	4.8	3.4	3.3	4.5	3.7	3.4
	Temp	46.6	52.1	61	71.7	78.7	86.2	91.7	91.8	83.9	73.4	60
Pawnee	Precip	1.2	1.6	2.8	3.3	5.2	4.4	3.3	3	4	3.1	2.2
	Temp	47.8	53.4	62.1	72.8	79.9	87.8	93.7	93.6	85.3	74.9	60.9
Payne	Precip	1.2	1.6	2.8	3.3	5.2	4.4	3.3	3	4	3.1	2.2
	Temp	47.8	53.4	62.1	72.8	79.9	87.8	93.7	93.6	85.3	74.9	60.9
Pittsburg	Precip	1.9	2.3	3.5	4.2	5.6	4.4	3.5	2.9	4.5	3.8	3.2
	Temp	50.1	55.5	64	73.7	80.3	87.8	93.6	93.7	85.9	75.8	62.6
Pontotoc	Precip	1.6	2	3.1	3.7	5.5	4.3	3	2.8	4.2	3.8	2.6
	Temp	50.8	56.3	64.6	74.1	80.8	88.3	94	94.1	86.3	76.2	63
Pottawatomie	Precip	1.4	1.8	2.8	3.5	5.4	4.5	3	2.8	4.1	3.5	2.4
	Temp	49.4	54.9	63.4	73.3	80.1	87.8	93.6	93.6	85.5	75.2	61.8
Pushmataha	Precip	2.7	3.1	4.1	4.9	6.1	4.4	4	3.1	4.8	4.3	4
	Temp	51.7	56.8	64.9	74	80.4	87.5	93	93.3	85.9	76	63.4

Table C1: Historical Average Weather Variables by County and Month

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Roger Mills	Precip	0.6	1	1.8	2.2	4.3	3.6	2.1	2.5	2.6	2.2	1.3
	Temp	49.4	54.3	62.7	73	80.6	89.1	94.6	93.4	85.2	74.6	60.6
Rogers	Precip	1.7	1.9	3.3	3.9	5.3	4.8	3.3	3	4.2	3.6	3
	Temp	46.4	52.1	60.7	71.3	78.8	86.7	92.5	92.5	84.3	73.9	60.2
Seminole	Precip	1.9	2.3	3.5	4.2	5.6	4.4	3.5	2.9	4.5	3.8	3.2
	Temp	50.1	55.5	64	73.7	80.3	87.8	93.6	93.7	85.9	75.8	62.6
Sequoyah	Precip	2.4	2.7	3.8	4.4	5.7	4.4	3.7	2.9	4.3	3.9	4
	Temp	49.7	54.9	63.3	73.4	80.1	87.4	93	92.9	85.4	75.3	62.2
Stephens	Precip	1.2	1.5	2.4	2.8	5.2	4.1	2.4	2.6	3.5	3.3	2
	Temp	51.7	57	65.5	74.8	82	89.7	95.3	95.1	87.1	76.7	63.4
Texas	Precip	0.4	0.5	1.1	1.3	2.7	2.7	2.7	2.5	1.7	1.1	0.7
	Temp	48.7	53.1	60.6	70.9	79.5	89.1	93.7	91.7	84	73.6	59
Tillman	Precip	1	1.4	2	2.4	4.6	3.8	2.2	2.5	3.1	3	1.7
	Temp	52.5	57.7	66.3	76.1	83.8	92.2	97.5	96.8	88.4	77.8	63.9
Tulsa	Precip	1.6	2	3.2	3.9	5.4	4.5	3.3	2.8	4.2	3.6	2.9
	Temp	48.2	53.8	62.4	72.7	79.6	87.3	93.1	93.1	85	74.9	61.4
Wagoner	Precip	1.8	2	3.3	4	5.4	4.5	3.2	2.9	4.3	3.8	3.2
	Temp	47.9	53.5	62.3	72.6	79.6	87.3	93.1	93	85	74.7	61.2
Washington	Precip	1.3	1.6	3	3.6	5.3	4.9	3.4	3.2	4.1	3.3	2.5
	Temp	46.5	52.4	61.4	72.3	79.4	87.2	93.1	93	84.7	74.1	60.2
Washita	Precip	0.9	1.1	2	2.4	4.6	3.9	2.4	2.7	2.9	2.6	1.4
	Temp	49.7	54.9	63.4	73.6	81.5	90.2	95.6	94.8	86.3	75.4	61.3
Woods	Precip	0.6	0.8	1.7	2	3.6	3.6	2.7	2.8	2.2	1.7	1.1
	Temp	48	53.2	61.6	72.4	80.6	89.7	95.2	94	85.6	74.9	59.9
Woodward	Precip	0.5	0.8	1.6	1.7	3.3	3.4	2.7	2.6	2	1.6	1
	Temp	47.6	52.5	60.5	71.3	79.5	88.7	94.1	93	84.6	73.9	59.3

*Total monthly precipitation in inches

**Average maximum daily temperature in degrees Fahrenheit

Table C2: Climate Scenario Hot/Dry in 2060 Weather Variables by County and Month [Q1]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adair	Precip*	2.3	2.7	4.1	4.8	6	5	3.6	3.7	4.8	3.9	4.2	3.1
	Temp**	51.2	56.7	64.7	74.9	81.9	89.2	95.3	95.4	87.8	78	64.1	53.8
Alfalfa	Precip	0.9	1.3	2.7	2.9	4.5	4.9	3.3	3.5	3.4	2.8	1.9	1.3
	Temp	49.4	55.4	64.1	74.9	83.8	93.1	99.1	98.5	89.7	78.9	62.8	51.6
Atoka	Precip	2	2.6	3.7	4.7	5.8	4.8	3.3	3	4.9	3.9	3.5	2.9
	Temp	54.1	59.7	67.5	77	83.9	91.3	97.4	98	90.3	80.6	66.9	56.8
Beaver	Precip	0.6	0.9	1.9	1.8	3.5	3.9	2.8	2.8	2.2	1.6	1.1	0.9
	Temp	50.4	55.6	63.5	74.3	82.9	91.7	97.6	97	88.6	78.2	62.5	52.1
Beckham	Precip	0.8	1.2	2	2.4	4.8	4.2	2.3	2.6	3.1	2.6	1.5	1.2
	Temp	53.2	58.6	67	77.3	85.3	93.5	99.3	98.6	90.4	80.1	65	55
Blaine	Precip	0.9	1.3	2.5	2.8	4.9	4.7	2.8	3.1	3.5	2.7	1.9	1.4
	Temp	51	56.7	65.2	75.7	84.1	92.8	98.9	98.5	89.9	79.3	63.7	53
Bryan	Precip	1.9	2.5	3.6	4.4	5.6	4.9	2.9	2.8	4.8	4.1	3.2	2.7
	Temp	54.7	60.1	67.9	77.2	84.2	91.6	97.4	98	90.4	80.8	67.1	57.2
Caddo	Precip	1.1	1.6	2.5	3.1	5.4	4.5	2.6	3	3.8	3.2	2	1.7
	Temp	52.9	58.7	67.1	77	84.6	92.1	98.1	97.9	90.1	80	65.4	55.1
Canadian	Precip	0.9	1.4	2.5	2.8	5.2	4.7	2.5	3	3.6	2.9	1.9	1.4
	Temp	51.1	56.6	65	75.2	83.4	91.5	97.6	97.4	89	78.6	63.5	53.1
Carter	Precip	1.5	2	3	3.6	5.7	4.5	2.7	2.7	4.3	3.7	2.6	2.2
	Temp	54.5	60.1	68.1	77.6	84.6	92	98	98.5	90.6	80.8	66.7	56.7
Cherokee	Precip	2.3	2.7	4.1	4.8	6	5	3.6	3.7	4.8	3.9	4.2	3.1
	Temp	51.2	56.7	64.7	74.9	81.9	89.2	95.3	95.4	87.8	78	64.1	53.8
Choctaw	Precip	2.7	3.4	4.1	4.8	5.8	4.5	3.6	3.1	4.9	4.3	4.4	3.9
	Temp	56.5	61.8	69.4	78.3	85.2	92.2	97.6	98.3	91.1	81.7	68.4	58.7
Cimarron	Precip	0.4	0.5	1.3	1.3	2.8	3.1	2.8	2.6	1.9	1.2	0.7	0.6
	Temp	51.4	56.1	63.5	74	83.1	92.3	97.1	95.9	88.1	77.9	62.1	52.6
Cleveland	Precip	1.4	2	3	3.7	5.8	4.8	3	3	4.4	3.6	2.6	2.1
	Temp	52.7	58.6	66.7	76.6	83.7	91.1	97.4	97.7	89.7	79.8	65.4	55.1
Coal	Precip	2	2.6	3.7	4.7	5.8	4.8	3.3	3	4.9	3.9	3.5	2.9
	Temp	54.1	59.7	67.5	77	83.9	91.3	97.4	98	90.3	80.6	66.9	56.8
Comanche	Precip	1.1	1.6	2.4	2.8	5.4	4.5	2.5	2.7	3.6	3.2	2	1.7
	Temp	53.9	59.4	67.6	77.5	85.1	92.8	98.9	99	90.8	80.6	65.9	55.8

Table C2: Climate Scenario Hot/Dry in 2060 Weather Variables by County and Month [Q1]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cotton	Precip	1.1	1.6	2.4	2.8	5.4	4.5	2.5	2.7	3.6	3.2	2	1.7
	Temp	53.9	59.4	67.6	77.5	85.1	92.8	98.9	99	90.8	80.6	65.9	55.8
Craig	Precip	1.9	2.3	3.8	4.4	5.9	5.1	3.4	3.7	4.9	3.9	3.7	2.8
	Temp	50.3	56.2	64.6	74.9	82.2	89.7	95.8	96.1	88.2	78.2	63.9	53.2
Creek	Precip	1.7	2.2	3.5	4.1	5.7	4.9	3.3	3.1	4.6	3.8	3.3	2.4
	Temp	51.2	57.1	65.3	75.7	82.8	90.5	96.8	96.9	88.9	79.1	64.8	54
Custer	Precip	0.9	1.3	2.2	2.5	5	4.4	2.4	2.8	3.2	2.7	1.6	1.3
	Temp	52.6	58.1	66.4	76.6	84.8	93.1	99.1	98.7	90.3	79.8	64.6	54.4
Delaware	Precip	1.8	2.2	3.7	4.2	5.8	5.1	3.4	3.7	5.1	3.8	3.7	2.6
	Temp	49.7	55.5	64	74.6	81.9	89.4	95.4	95.7	87.7	77.6	63.4	52.6
Dewey	Precip	0.7	1.2	2.2	2.5	4.8	4.3	2.4	2.9	3	2.4	1.6	1.2
	Temp	51	56.3	64.5	74.9	83.2	91.7	97.8	97.3	88.8	78.3	63.1	52.8
Ellis	Precip	0.6	1	1.9	2	4	4	2.5	2.7	2.3	1.9	1.2	1
	Temp	50.3	55.4	63.3	74.1	82.3	90.8	96.8	96.4	87.9	77.7	62.3	52
Garfield	Precip	1	1.5	2.8	3.1	5.3	4.9	3.1	3.2	4.1	3	2.2	1.6
	Temp	50.6	56.4	65	75.5	83.7	92	98.3	98.2	89.7	79.2	63.7	52.9
Garvin	Precip	1.5	2	3	3.6	5.7	4.5	2.7	2.7	4.3	3.7	2.6	2.2
	Temp	54.5	60.1	68.1	77.6	84.6	92	98	98.5	90.6	80.8	66.7	56.7
Grady	Precip	1.1	1.6	2.5	3.1	5.4	4.5	2.6	3	3.8	3.2	2	1.7
	Temp	52.9	58.7	67.1	77	84.6	92.1	98.1	97.9	90.1	80	65.4	55.1
Grant	Precip	0.9	1.3	2.7	2.9	4.5	4.9	3.3	3.5	3.4	2.8	1.9	1.3
	Temp	49.4	55.4	64.1	74.9	83.8	93.1	99.1	98.5	89.7	78.9	62.8	51.6
Greer	Precip	0.8	1.2	1.8	2.3	4.7	4.3	2.3	2.7	3.1	2.6	1.4	1.2
	Temp	54.8	60.4	69	79.3	87	94.8	100.4	99.8	91.7	81.6	66.5	56.4
Harmon	Precip	0.7	1.1	1.6	2.2	4	4	2.2	2.5	3	2.4	1.3	1.1
	Temp	56.1	61.6	70.2	80.4	88.2	96	101.1	100.4	92.3	82.3	67.4	57.6
Harper	Precip	0.6	1	2	2.1	3.9	4.2	2.8	3	2.5	1.8	1.3	1
	Temp	50.9	56.4	64.6	75.4	83.9	92.7	98.7	98	89.5	79.2	63.2	52.6
Haskell	Precip	2.4	2.9	4.1	4.8	6	4.7	3.7	3.2	4.7	3.9	4.4	3.2
	Temp	52.7	58.2	66.1	76.3	83.3	90.7	96.7	96.8	89.2	79.5	65.5	55.2
Hughes	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5	2.8
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9	55.7

Table C2: Climate Scenario Hot/Dry in 2060 Weather Variables by County and Month [Q1]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jackson	Precip	0.9	1.3	2	2.4	4.8	4.3	2.3	2.7	3.2	2.7	1.6	1.4
	Temp	54.3	59.8	68.2	78.3	86.4	94.6	100.2	99.5	91.2	81	66.1	56
Jefferson	Precip	1.3	1.8	2.5	3.1	5.1	4.3	2.4	2.6	3.7	3.2	2.1	1.9
	Temp	57	62.5	70.6	79.9	87	94.3	100.3	100.5	92.6	82.9	68.7	59.1
Johnston	Precip	1.8	2.4	3.3	4.1	5.4	4.7	2.7	2.6	4.5	3.9	2.8	2.5
	Temp	55.6	60.9	68.7	78	84.9	92.3	98.1	98.7	91	81.4	67.6	57.8
Kay	Precip	1.1	1.6	3	3.4	5.2	5.1	3.6	3.6	4.3	3.1	2.3	1.6
	Temp	49.2	55.4	64.1	74.8	82.9	91.2	97.5	97.3	88.8	78.4	62.9	51.6
Kingfisher	Precip	0.9	1.3	2.5	2.8	4.9	4.7	2.8	3.1	3.5	2.7	1.9	1.4
	Temp	51	56.7	65.2	75.7	84.1	92.8	98.9	98.5	89.9	79.3	63.7	53
Kiowa	Precip	0.8	1.2	2	2.4	4.8	4.2	2.3	2.6	3.1	2.6	1.5	1.2
	Temp	53.2	58.6	67	77.3	85.3	93.5	99.3	98.6	90.4	80.1	65	55
Latimer	Precip	2.8	3.1	4.4	5.1	6.3	4.6	4	3.3	4.8	4	4.7	3.7
	Temp	54.3	59.6	67.3	77.1	84	91.3	97.1	97.3	89.7	80.2	66.7	56.7
Le Flore	Precip	2.8	3.1	4.4	5.1	6.3	4.6	4	3.3	4.8	4	4.7	3.7
	Temp	54.3	59.6	67.3	77.1	84	91.3	97.1	97.3	89.7	80.2	66.7	56.7
Lincoln	Precip	1.3	1.9	3.1	3.7	5.8	4.9	3.2	3	4.5	3.5	2.7	2.1
	Temp	52.3	58.1	66.3	76.5	83.5	91	97.4	97.7	89.6	79.7	65.2	54.7
Logan	Precip	1	1.5	2.8	3.1	5.3	4.9	3.1	3.2	4.1	3	2.2	1.6
	Temp	50.6	56.4	65	75.5	83.7	92	98.3	98.2	89.7	79.2	63.7	52.9
Love	Precip	1.8	2.4	3.3	4.1	5.4	4.7	2.7	2.6	4.5	3.9	2.8	2.5
	Temp	55.6	60.9	68.7	78	84.9	92.3	98.1	98.7	91	81.4	67.6	57.8
Major	Precip	0.9	1.3	2.5	2.8	4.9	4.7	2.8	3.1	3.5	2.7	1.9	1.4
	Temp	51	56.7	65.2	75.7	84.1	92.8	98.9	98.5	89.9	79.3	63.7	53
Marshall	Precip	1.8	2.4	3.3	4.1	5.4	4.7	2.7	2.6	4.5	3.9	2.8	2.5
	Temp	55.6	60.9	68.7	78	84.9	92.3	98.1	98.7	91	81.4	67.6	57.8
Mayes	Precip	1.9	2.3	3.8	4.4	5.9	5.1	3.4	3.7	4.9	3.9	3.7	2.8
	Temp	50.3	56.2	64.6	74.9	82.2	89.7	95.8	96.1	88.2	78.2	63.9	53.2
McClain	Precip	1.3	1.8	2.9	3.5	5.9	4.6	2.8	2.9	4.2	3.4	2.3	2
	Temp	52.9	58.7	67	76.8	84.1	91.5	97.8	98	90	80	65.5	55.1
McCurtain	Precip	3.1	3.7	4.5	4.9	5.6	4.3	3.8	2.8	4.6	4.2	4.7	4.3
	Temp	56.8	61.9	69.4	78.2	85.2	92.3	97.1	97.9	90.9	81.6	68.5	59

Table C2: Climate Scenario Hot/Dry in 2060 Weather Variables by County and Month [Q1]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
McIntosh	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5	2.8
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9	55.7
Murray	Precip	1.5	2	3	3.6	5.7	4.5	2.7	2.7	4.3	3.7	2.6	2.2
	Temp	54.5	60.1	68.1	77.6	84.6	92	98	98.5	90.6	80.8	66.7	56.7
Muskogee	Precip	2.1	2.5	3.8	4.6	5.9	4.7	3.5	3.1	4.8	4	3.9	2.9
	Temp	51.7	57.3	65.4	75.8	83	90.6	96.9	97.1	89.3	79.3	65.2	54.6
Noble	Precip	1.2	1.7	3.1	3.5	5.6	4.9	3.4	3.3	4.4	3.2	2.5	1.8
	Temp	50.8	56.7	65.1	75.7	83.1	90.9	97.3	97.5	89.2	79.1	64.2	53.3
Nowata	Precip	1.6	2	3.6	4.1	5.7	5.3	3.3	3.6	4.9	3.7	3.3	2.3
	Temp	49.3	55.6	64.2	74.7	82.3	90.3	96.6	96.8	88.5	78.2	63.6	52.3
Okfuskee	Precip	1.4	2	3.1	3.8	5.8	4.9	3	3	4.5	3.6	2.7	2.2
	Temp	52.4	58.2	66.3	76.3	83.4	90.8	97.2	97.5	89.4	79.5	65.2	54.8
Oklahoma	Precip	1.4	2	3.1	3.8	5.8	4.9	3	3	4.5	3.6	2.7	2.2
	Temp	52.4	58.2	66.3	76.3	83.4	90.8	97.2	97.5	89.4	79.5	65.2	54.8
Okmulgee	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5	2.8
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9	55.7
Osage	Precip	1.4	1.9	3.4	3.9	5.8	5.2	3.5	3.5	4.7	3.4	2.8	2
	Temp	50.2	56.4	64.9	75.5	82.7	90.3	96.7	97	88.7	78.6	63.9	52.8
Ottawa	Precip	1.8	2.2	3.7	4.2	5.8	5.1	3.4	3.7	5.1	3.8	3.7	2.6
	Temp	49.7	55.5	64	74.6	81.9	89.4	95.4	95.7	87.7	77.6	63.4	52.6
Pawnee	Precip	1.2	1.7	3.1	3.5	5.6	4.9	3.4	3.3	4.4	3.2	2.5	1.8
	Temp	50.8	56.7	65.1	75.7	83.1	90.9	97.3	97.5	89.2	79.1	64.2	53.3
Payne	Precip	1.2	1.7	3.1	3.5	5.6	4.9	3.4	3.3	4.4	3.2	2.5	1.8
	Temp	50.8	56.7	65.1	75.7	83.1	90.9	97.3	97.5	89.2	79.1	64.2	53.3
Pittsburg	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5	2.8
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9	55.7
Pontotoc	Precip	1.6	2.2	3.3	4	5.9	4.7	3	3	4.6	3.8	2.8	2.4
	Temp	53.7	59.5	67.5	77.1	84.1	91.4	97.5	98	90.2	80.4	66.3	56.1
Pottawatomie	Precip	1.4	2	3.1	3.8	5.8	4.9	3	3	4.5	3.6	2.7	2.2
	Temp	52.4	58.2	66.3	76.3	83.4	90.8	97.2	97.5	89.4	79.5	65.2	54.8
Pushmataha	Precip	2.8	3.2	4.3	5.2	6.4	4.7	4.1	3.3	5.2	4.3	4.4	3.8
	Temp	54.7	60	67.7	77	83.7	90.8	96.6	97.1	89.6	80.2	66.7	57

Table C2: Climate Scenario Hot/Dry in 2060 Weather Variables by County and Month [Q1]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Roger Mills	Precip	0.7	1.1	2	2.3	4.6	4.1	2.2	2.7	2.8	2.2	1.4	1.1
	Temp	52.2	57.5	65.6	76.1	83.9	92	98	97.4	89.1	79	63.9	53.8
Rogers	Precip	1.7	2.1	3.6	4.2	5.6	5.2	3.4	3.4	4.7	3.8	3.3	2.5
	Temp	49.4	55.5	63.7	74.3	82	89.9	96.2	96.4	88.2	78.1	63.6	52.6
Seminole	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5	2.8
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9	55.7
Sequoyah	Precip	2.4	2.9	4.1	4.8	6	4.7	3.7	3.2	4.7	3.9	4.4	3.2
	Temp	52.7	58.2	66.1	76.3	83.3	90.7	96.7	96.8	89.2	79.5	65.5	55.2
Stephens	Precip	1.2	1.7	2.6	3	5.6	4.5	2.5	2.7	3.8	3.3	2.2	1.9
	Temp	54.6	60.2	68.4	77.9	85.2	92.6	98.8	98.9	90.9	81	66.7	56.7
Texas	Precip	0.4	0.5	1.3	1.3	2.8	3.1	2.8	2.6	1.9	1.2	0.7	0.6
	Temp	51.4	56.1	63.5	74	83.1	92.3	97.1	95.9	88.1	77.9	62.1	52.6
Tillman	Precip	1	1.6	2.2	2.6	5	4.3	2.2	2.7	3.4	3	1.9	1.6
	Temp	55.4	60.9	69.2	79.2	87.1	95.2	101	100.6	92.3	82.1	67.2	57.2
Tulsa	Precip	1.7	2.2	3.5	4.1	5.7	4.9	3.3	3.1	4.6	3.8	3.3	2.4
	Temp	51.2	57.1	65.3	75.7	82.8	90.5	96.8	96.9	88.9	79.1	64.8	54
Wagoner	Precip	1.9	2.2	3.6	4.3	5.7	4.9	3.3	3.1	4.8	3.9	3.5	2.6
	Temp	50.9	56.8	65.2	75.5	82.9	90.5	96.7	96.9	88.8	78.9	64.6	53.8
Washington	Precip	1.4	1.8	3.4	3.9	5.7	5.3	3.5	3.5	4.6	3.5	2.8	2
	Temp	49.5	55.8	64.4	75.2	82.6	90.3	96.7	97	88.6	78.3	63.5	52.2
Washita	Precip	0.9	1.3	2.2	2.5	5	4.4	2.4	2.8	3.2	2.7	1.6	1.3
	Temp	52.6	58.1	66.4	76.6	84.8	93.1	99.1	98.7	90.3	79.8	64.6	54.4
Woods	Precip	0.6	1	2	2.1	3.9	4.2	2.8	3	2.5	1.8	1.3	1
	Temp	50.9	56.4	64.6	75.4	83.9	92.7	98.7	98	89.5	79.2	63.2	52.6
Woodward	Precip	0.6	0.9	1.9	1.8	3.5	3.9	2.8	2.8	2.2	1.6	1.1	0.9
	Temp	50.4	55.6	63.5	74.3	82.9	91.7	97.6	97	88.6	78.2	62.5	52.1

*Total monthly precipitation in inches

**Average maximum daily temperature in degrees Fahrenheit

Table C3: Climate Scenario Warm/Wet in 2060 Weather Variables by County and Month [Q4]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Adair	Precip*	2.3	2.7	4.1	4.8	6	5	3.6	3.7	4.8	3.9	4.2
	Temp**	51.2	56.7	64.7	74.9	81.9	89.2	95.3	95.4	87.8	78	64.1
Alfalfa	Precip	0.9	1.3	2.7	2.9	4.5	4.9	3.3	3.5	3.4	2.8	1.9
	Temp	49.4	55.4	64.1	74.9	83.8	93.1	99.1	98.5	89.7	78.9	62.8
Atoka	Precip	2	2.6	3.7	4.7	5.8	4.8	3.3	3	4.9	3.9	3.5
	Temp	54.1	59.7	67.5	77	83.9	91.3	97.4	98	90.3	80.6	66.9
Beaver	Precip	0.6	0.9	1.9	1.8	3.5	3.9	2.8	2.8	2.2	1.6	1.1
	Temp	50.4	55.6	63.5	74.3	82.9	91.7	97.6	97	88.6	78.2	62.5
Beckham	Precip	0.8	1.2	2	2.4	4.8	4.2	2.3	2.6	3.1	2.6	1.5
	Temp	53.2	58.6	67	77.3	85.3	93.5	99.3	98.6	90.4	80.1	65
Blaine	Precip	0.9	1.3	2.5	2.8	4.9	4.7	2.8	3.1	3.5	2.7	1.9
	Temp	51	56.7	65.2	75.7	84.1	92.8	98.9	98.5	89.9	79.3	63.7
Bryan	Precip	1.9	2.5	3.6	4.4	5.6	4.9	2.9	2.8	4.8	4.1	3.2
	Temp	54.7	60.1	67.9	77.2	84.2	91.6	97.4	98	90.4	80.8	67.1
Caddo	Precip	1.1	1.6	2.5	3.1	5.4	4.5	2.6	3	3.8	3.2	2
	Temp	52.9	58.7	67.1	77	84.6	92.1	98.1	97.9	90.1	80	65.4
Canadian	Precip	0.9	1.4	2.5	2.8	5.2	4.7	2.5	3	3.6	2.9	1.9
	Temp	51.1	56.6	65	75.2	83.4	91.5	97.6	97.4	89	78.6	63.5
Carter	Precip	1.5	2	3	3.6	5.7	4.5	2.7	2.7	4.3	3.7	2.6
	Temp	54.5	60.1	68.1	77.6	84.6	92	98	98.5	90.6	80.8	66.7
Cherokee	Precip	2.3	2.7	4.1	4.8	6	5	3.6	3.7	4.8	3.9	4.2
	Temp	51.2	56.7	64.7	74.9	81.9	89.2	95.3	95.4	87.8	78	64.1
Choctaw	Precip	2.7	3.4	4.1	4.8	5.8	4.5	3.6	3.1	4.9	4.3	4.4
	Temp	56.5	61.8	69.4	78.3	85.2	92.2	97.6	98.3	91.1	81.7	68.4
Cimarron	Precip	0.4	0.5	1.3	1.3	2.8	3.1	2.8	2.6	1.9	1.2	0.7
	Temp	51.4	56.1	63.5	74	83.1	92.3	97.1	95.9	88.1	77.9	62.1
Cleveland	Precip	1.4	2	3	3.7	5.8	4.8	3	3	4.4	3.6	2.6
	Temp	52.7	58.6	66.7	76.6	83.7	91.1	97.4	97.7	89.7	79.8	65.4
Coal	Precip	2	2.6	3.7	4.7	5.8	4.8	3.3	3	4.9	3.9	3.5
	Temp	54.1	59.7	67.5	77	83.9	91.3	97.4	98	90.3	80.6	66.9
Comanche	Precip	1.1	1.6	2.4	2.8	5.4	4.5	2.5	2.7	3.6	3.2	2
	Temp	53.9	59.4	67.6	77.5	85.1	92.8	98.9	99	90.8	80.6	65.9

Table C3: Climate Scenario Warm/Wet in 2060 Weather Variables by County and Month [Q4]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Cotton	Precip	1.1	1.6	2.4	2.8	5.4	4.5	2.5	2.7	3.6	3.2	2
	Temp	53.9	59.4	67.6	77.5	85.1	92.8	98.9	99	90.8	80.6	65.9
Craig	Precip	1.9	2.3	3.8	4.4	5.9	5.1	3.4	3.7	4.9	3.9	3.7
	Temp	50.3	56.2	64.6	74.9	82.2	89.7	95.8	96.1	88.2	78.2	63.9
Creek	Precip	1.7	2.2	3.5	4.1	5.7	4.9	3.3	3.1	4.6	3.8	3.3
	Temp	51.2	57.1	65.3	75.7	82.8	90.5	96.8	96.9	88.9	79.1	64.8
Custer	Precip	0.9	1.3	2.2	2.5	5	4.4	2.4	2.8	3.2	2.7	1.6
	Temp	52.6	58.1	66.4	76.6	84.8	93.1	99.1	98.7	90.3	79.8	64.6
Delaware	Precip	1.8	2.2	3.7	4.2	5.8	5.1	3.4	3.7	5.1	3.8	3.7
	Temp	49.7	55.5	64	74.6	81.9	89.4	95.4	95.7	87.7	77.6	63.4
Dewey	Precip	0.7	1.2	2.2	2.5	4.8	4.3	2.4	2.9	3	2.4	1.6
	Temp	51	56.3	64.5	74.9	83.2	91.7	97.8	97.3	88.8	78.3	63.1
Ellis	Precip	0.6	1	1.9	2	4	4	2.5	2.7	2.3	1.9	1.2
	Temp	50.3	55.4	63.3	74.1	82.3	90.8	96.8	96.4	87.9	77.7	62.3
Garfield	Precip	1	1.5	2.8	3.1	5.3	4.9	3.1	3.2	4.1	3	2.2
	Temp	50.6	56.4	65	75.5	83.7	92	98.3	98.2	89.7	79.2	63.7
Garvin	Precip	1.5	2	3	3.6	5.7	4.5	2.7	2.7	4.3	3.7	2.6
	Temp	54.5	60.1	68.1	77.6	84.6	92	98	98.5	90.6	80.8	66.7
Grady	Precip	1.1	1.6	2.5	3.1	5.4	4.5	2.6	3	3.8	3.2	2
	Temp	52.9	58.7	67.1	77	84.6	92.1	98.1	97.9	90.1	80	65.4
Grant	Precip	0.9	1.3	2.7	2.9	4.5	4.9	3.3	3.5	3.4	2.8	1.9
	Temp	49.4	55.4	64.1	74.9	83.8	93.1	99.1	98.5	89.7	78.9	62.8
Greer	Precip	0.8	1.2	1.8	2.3	4.7	4.3	2.3	2.7	3.1	2.6	1.4
	Temp	54.8	60.4	69	79.3	87	94.8	100.4	99.8	91.7	81.6	66.5
Harmon	Precip	0.7	1.1	1.6	2.2	4	4	2.2	2.5	3	2.4	1.3
	Temp	56.1	61.6	70.2	80.4	88.2	96	101.1	100.4	92.3	82.3	67.4
Harper	Precip	0.6	1	2	2.1	3.9	4.2	2.8	3	2.5	1.8	1.3
	Temp	50.9	56.4	64.6	75.4	83.9	92.7	98.7	98	89.5	79.2	63.2
Haskell	Precip	2.4	2.9	4.1	4.8	6	4.7	3.7	3.2	4.7	3.9	4.4
	Temp	52.7	58.2	66.1	76.3	83.3	90.7	96.7	96.8	89.2	79.5	65.5
Hughes	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9

Table C3: Climate Scenario Warm/Wet in 2060 Weather Variables by County and Month [Q4]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Jackson	Precip	0.9	1.3	2	2.4	4.8	4.3	2.3	2.7	3.2	2.7	1.6
	Temp	54.3	59.8	68.2	78.3	86.4	94.6	100.2	99.5	91.2	81	66.1
Jefferson	Precip	1.3	1.8	2.5	3.1	5.1	4.3	2.4	2.6	3.7	3.2	2.1
	Temp	57	62.5	70.6	79.9	87	94.3	100.3	100.5	92.6	82.9	68.7
Johnston	Precip	1.8	2.4	3.3	4.1	5.4	4.7	2.7	2.6	4.5	3.9	2.8
	Temp	55.6	60.9	68.7	78	84.9	92.3	98.1	98.7	91	81.4	67.6
Kay	Precip	1.1	1.6	3	3.4	5.2	5.1	3.6	3.6	4.3	3.1	2.3
	Temp	49.2	55.4	64.1	74.8	82.9	91.2	97.5	97.3	88.8	78.4	62.9
Kingfisher	Precip	0.9	1.3	2.5	2.8	4.9	4.7	2.8	3.1	3.5	2.7	1.9
	Temp	51	56.7	65.2	75.7	84.1	92.8	98.9	98.5	89.9	79.3	63.7
Kiowa	Precip	0.8	1.2	2	2.4	4.8	4.2	2.3	2.6	3.1	2.6	1.5
	Temp	53.2	58.6	67	77.3	85.3	93.5	99.3	98.6	90.4	80.1	65
Latimer	Precip	2.8	3.1	4.4	5.1	6.3	4.6	4	3.3	4.8	4	4.7
	Temp	54.3	59.6	67.3	77.1	84	91.3	97.1	97.3	89.7	80.2	66.7
Le Flore	Precip	2.8	3.1	4.4	5.1	6.3	4.6	4	3.3	4.8	4	4.7
	Temp	54.3	59.6	67.3	77.1	84	91.3	97.1	97.3	89.7	80.2	66.7
Lincoln	Precip	1.3	1.9	3.1	3.7	5.8	4.9	3.2	3	4.5	3.5	2.7
	Temp	52.3	58.1	66.3	76.5	83.5	91	97.4	97.7	89.6	79.7	65.2
Logan	Precip	1	1.5	2.8	3.1	5.3	4.9	3.1	3.2	4.1	3	2.2
	Temp	50.6	56.4	65	75.5	83.7	92	98.3	98.2	89.7	79.2	63.7
Love	Precip	1.8	2.4	3.3	4.1	5.4	4.7	2.7	2.6	4.5	3.9	2.8
	Temp	55.6	60.9	68.7	78	84.9	92.3	98.1	98.7	91	81.4	67.6
Major	Precip	0.9	1.3	2.5	2.8	4.9	4.7	2.8	3.1	3.5	2.7	1.9
	Temp	51	56.7	65.2	75.7	84.1	92.8	98.9	98.5	89.9	79.3	63.7
Marshall	Precip	1.8	2.4	3.3	4.1	5.4	4.7	2.7	2.6	4.5	3.9	2.8
	Temp	55.6	60.9	68.7	78	84.9	92.3	98.1	98.7	91	81.4	67.6
Mayes	Precip	1.9	2.3	3.8	4.4	5.9	5.1	3.4	3.7	4.9	3.9	3.7
	Temp	50.3	56.2	64.6	74.9	82.2	89.7	95.8	96.1	88.2	78.2	63.9
McClain	Precip	1.3	1.8	2.9	3.5	5.9	4.6	2.8	2.9	4.2	3.4	2.3
	Temp	52.9	58.7	67	76.8	84.1	91.5	97.8	98	90	80	65.5
McCurtain	Precip	3.1	3.7	4.5	4.9	5.6	4.3	3.8	2.8	4.6	4.2	4.7
	Temp	56.8	61.9	69.4	78.2	85.2	92.3	97.1	97.9	90.9	81.6	68.5

Table C3: Climate Scenario Warm/Wet in 2060 Weather Variables by County and Month [Q4]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
McIntosh	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9
Murray	Precip	1.5	2	3	3.6	5.7	4.5	2.7	2.7	4.3	3.7	2.6
	Temp	54.5	60.1	68.1	77.6	84.6	92	98	98.5	90.6	80.8	66.7
Muskogee	Precip	2.1	2.5	3.8	4.6	5.9	4.7	3.5	3.1	4.8	4	3.9
	Temp	51.7	57.3	65.4	75.8	83	90.6	96.9	97.1	89.3	79.3	65.2
Noble	Precip	1.2	1.7	3.1	3.5	5.6	4.9	3.4	3.3	4.4	3.2	2.5
	Temp	50.8	56.7	65.1	75.7	83.1	90.9	97.3	97.5	89.2	79.1	64.2
Nowata	Precip	1.6	2	3.6	4.1	5.7	5.3	3.3	3.6	4.9	3.7	3.3
	Temp	49.3	55.6	64.2	74.7	82.3	90.3	96.6	96.8	88.5	78.2	63.6
Okfuskee	Precip	1.4	2	3.1	3.8	5.8	4.9	3	3	4.5	3.6	2.7
	Temp	52.4	58.2	66.3	76.3	83.4	90.8	97.2	97.5	89.4	79.5	65.2
Oklahoma	Precip	1.4	2	3.1	3.8	5.8	4.9	3	3	4.5	3.6	2.7
	Temp	52.4	58.2	66.3	76.3	83.4	90.8	97.2	97.5	89.4	79.5	65.2
Okmulgee	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9
Osage	Precip	1.4	1.9	3.4	3.9	5.8	5.2	3.5	3.5	4.7	3.4	2.8
	Temp	50.2	56.4	64.9	75.5	82.7	90.3	96.7	97	88.7	78.6	63.9
Ottawa	Precip	1.8	2.2	3.7	4.2	5.8	5.1	3.4	3.7	5.1	3.8	3.7
	Temp	49.7	55.5	64	74.6	81.9	89.4	95.4	95.7	87.7	77.6	63.4
Pawnee	Precip	1.2	1.7	3.1	3.5	5.6	4.9	3.4	3.3	4.4	3.2	2.5
	Temp	50.8	56.7	65.1	75.7	83.1	90.9	97.3	97.5	89.2	79.1	64.2
Payne	Precip	1.2	1.7	3.1	3.5	5.6	4.9	3.4	3.3	4.4	3.2	2.5
	Temp	50.8	56.7	65.1	75.7	83.1	90.9	97.3	97.5	89.2	79.1	64.2
Pittsburg	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9
Pontotoc	Precip	1.6	2.2	3.3	4	5.9	4.7	3	3	4.6	3.8	2.8
	Temp	53.7	59.5	67.5	77.1	84.1	91.4	97.5	98	90.2	80.4	66.3
Pottawatomie	Precip	1.4	2	3.1	3.8	5.8	4.9	3	3	4.5	3.6	2.7
	Temp	52.4	58.2	66.3	76.3	83.4	90.8	97.2	97.5	89.4	79.5	65.2
Pushmataha	Precip	2.8	3.2	4.3	5.2	6.4	4.7	4.1	3.3	5.2	4.3	4.4
	Temp	54.7	60	67.7	77	83.7	90.8	96.6	97.1	89.6	80.2	66.7

Table C3: Climate Scenario Warm/Wet in 2060 Weather Variables by County and Month [Q4]

County	Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Roger Mills	Precip	0.7	1.1	2	2.3	4.6	4.1	2.2	2.7	2.8	2.2	1.4
	Temp	52.2	57.5	65.6	76.1	83.9	92	98	97.4	89.1	79	63.9
Rogers	Precip	1.7	2.1	3.6	4.2	5.6	5.2	3.4	3.4	4.7	3.8	3.3
	Temp	49.4	55.5	63.7	74.3	82	89.9	96.2	96.4	88.2	78.1	63.6
Seminole	Precip	2	2.4	3.7	4.6	6	4.7	3.5	3.1	4.9	3.9	3.5
	Temp	53.1	58.7	66.8	76.6	83.6	91	97.2	97.5	89.7	80	65.9
Sequoyah	Precip	2.4	2.9	4.1	4.8	6	4.7	3.7	3.2	4.7	3.9	4.4
	Temp	52.7	58.2	66.1	76.3	83.3	90.7	96.7	96.8	89.2	79.5	65.5
Stephens	Precip	1.2	1.7	2.6	3	5.6	4.5	2.5	2.7	3.8	3.3	2.2
	Temp	54.6	60.2	68.4	77.9	85.2	92.6	98.8	98.9	90.9	81	66.7
Texas	Precip	0.4	0.5	1.3	1.3	2.8	3.1	2.8	2.6	1.9	1.2	0.7
	Temp	51.4	56.1	63.5	74	83.1	92.3	97.1	95.9	88.1	77.9	62.1
Tillman	Precip	1	1.6	2.2	2.6	5	4.3	2.2	2.7	3.4	3	1.9
	Temp	55.4	60.9	69.2	79.2	87.1	95.2	101	100.6	92.3	82.1	67.2
Tulsa	Precip	1.7	2.2	3.5	4.1	5.7	4.9	3.3	3.1	4.6	3.8	3.3
	Temp	51.2	57.1	65.3	75.7	82.8	90.5	96.8	96.9	88.9	79.1	64.8
Wagoner	Precip	1.9	2.2	3.6	4.3	5.7	4.9	3.3	3.1	4.8	3.9	3.5
	Temp	50.9	56.8	65.2	75.5	82.9	90.5	96.7	96.9	88.8	78.9	64.6
Washington	Precip	1.4	1.8	3.4	3.9	5.7	5.3	3.5	3.5	4.6	3.5	2.8
	Temp	49.5	55.8	64.4	75.2	82.6	90.3	96.7	97	88.6	78.3	63.5
Washita	Precip	0.9	1.3	2.2	2.5	5	4.4	2.4	2.8	3.2	2.7	1.6
	Temp	52.6	58.1	66.4	76.6	84.8	93.1	99.1	98.7	90.3	79.8	64.6
Woods	Precip	0.6	1	2	2.1	3.9	4.2	2.8	3	2.5	1.8	1.3
	Temp	50.9	56.4	64.6	75.4	83.9	92.7	98.7	98	89.5	79.2	63.2
Woodward	Precip	0.6	0.9	1.9	1.8	3.5	3.9	2.8	2.8	2.2	1.6	1.1
	Temp	50.4	55.6	63.5	74.3	82.9	91.7	97.6	97	88.6	78.2	62.5

*Total monthly precipitation in inches

**Average maximum daily temperature in degrees Fahrenheit

Appendix D
County Results of Climate Change Demand Scenarios in AFY

Table D1 : County Results of M&I Demand Scenarios in AFY

County	Baseline		Hot/Dry		Warm/Wet	
	2030	2060	2030	2060	2030	2060
Adair	2,555	3,526	2,691	3,862	2,617	3,675
Alfalfa	882	912	928	998	902	948
Atoka	3,733	4,913	3,924	5,357	3,825	5,120
Beaver	752	789	793	866	770	821
Beckham	5,562	6,930	5,839	7,547	5,692	7,203
Blaine	2,918	3,642	3,069	3,981	2,984	3,786
Bryan	9,799	12,388	10,291	13,486	10,039	12,903
Caddo	3,578	3,892	3,758	4,241	3,662	4,047
Canadian	18,000	20,884	19,002	22,961	18,454	21,792
Carter	10,048	11,643	10,576	12,726	10,301	12,140
Cherokee	8,760	11,751	9,226	12,871	8,972	12,247
Choctaw	1,667	1,790	1,750	1,946	1,708	1,864
Cimarron	705	746	743	819	723	777
Cleveland	42,804	47,126	45,139	51,651	43,892	49,178
Coal	805	1,132	846	1,234	824	1,180
Comanche	18,717	20,376	19,633	22,158	19,155	21,176
Cotton	821	869	861	945	840	903
Craig	2,739	3,534	2,884	3,871	2,805	3,682
Creek	9,391	10,715	9,880	11,710	9,612	11,152
Custer	5,852	6,414	6,145	6,989	5,988	6,666
Delaware	5,384	7,377	5,671	8,090	5,514	7,689
Dewey	1,146	1,197	1,205	1,308	1,172	1,244
Ellis	730	730	769	801	747	760
Garfield	13,049	13,842	13,780	15,229	13,373	14,441
Garvin	5,014	5,311	5,277	5,804	5,140	5,537
Grady	5,848	6,715	6,166	7,364	5,996	7,006
Grant	752	794	794	875	770	828
Greer	1,049	1,103	1,100	1,199	1,074	1,145
Harmon	821	894	860	970	840	928
Harper	973	1,001	1,024	1,098	995	1,041
Haskell	1,648	2,243	1,738	2,457	1,690	2,340
Hughes	2,178	2,866	2,293	3,134	2,232	2,989
Jackson	5,129	5,590	5,379	6,077	5,248	5,807
Jefferson	807	866	847	943	827	902
Johnston	2,196	2,923	2,304	3,177	2,250	3,043
Kay	8,272	8,860	8,749	9,776	8,479	9,250
Kingfisher	3,529	4,575	3,727	5,034	3,616	4,771
Kiowa	1,287	1,351	1,351	1,472	1,317	1,405
Latimer	2,506	2,961	2,640	3,240	2,569	3,090
Le Flore	7,499	8,895	7,900	9,732	7,688	9,281
Lincoln	2,745	3,322	2,896	3,647	2,814	3,467
Logan	5,883	7,483	6,212	8,232	6,029	7,806
Love	5,455	6,498	5,732	7,083	5,592	6,772
Major	1,013	1,054	1,066	1,152	1,036	1,095

Table D1 : County Results of M&I Demand Scenarios in AFY

County	Baseline		Hot/Dry		Warm/Wet	
	2030	2060	2030	2060	2030	2060
Marshall	4,333	6,586	4,545	7,158	4,438	6,855
Mayes	6,526	8,200	6,871	8,982	6,683	8,543
McClain	5,428	7,400	5,722	8,108	5,565	7,719
McCurtain	4,685	5,099	4,917	5,545	4,800	5,310
McIntosh	3,066	4,202	3,229	4,595	3,142	4,382
Murray	3,216	4,059	3,385	4,437	3,297	4,233
Muskogee	10,898	11,720	11,463	12,800	11,158	12,205
Noble	1,815	1,955	1,918	2,153	1,861	2,041
Nowata	1,412	1,907	1,487	2,089	1,446	1,986
Okfuskee	1,497	1,616	1,573	1,763	1,532	1,681
Oklahoma	136,613	146,570	144,183	160,911	140,120	153,050
Okmulgee	12,415	14,645	13,051	15,971	12,710	15,241
Osage	8,876	10,073	9,342	11,025	9,081	10,481
Ottawa	5,918	7,069	6,234	7,752	6,061	7,368
Pawnee	2,818	3,574	2,965	3,909	2,883	3,717
Payne	14,671	17,045	15,495	18,756	15,035	17,788
Pittsburg	9,150	10,471	9,634	11,449	9,377	10,918
Pontotoc	6,596	7,222	6,954	7,910	6,764	7,536
Pottawatomie	6,848	7,963	7,224	8,734	7,022	8,311
Pushmataha	1,371	1,834	1,443	2,003	1,406	1,913
Roger Mills	626	626	658	684	641	651
Rogers	16,213	20,212	17,066	22,128	16,598	21,049
Seminole	3,002	3,261	3,167	3,577	3,079	3,405
Sequoyah	8,886	11,099	9,367	12,161	9,109	11,583
Stephens	8,866	9,291	9,327	10,152	9,090	9,686
Texas	5,513	8,242	5,807	9,049	5,651	8,582
Tillman	1,418	1,521	1,485	1,650	1,450	1,579
Tulsa	121,517	130,319	127,837	142,428	124,378	135,643
Wagoner	10,137	12,383	10,665	13,538	10,377	12,892
Washington	12,486	13,021	13,144	14,259	12,776	13,552
Washita	1,179	1,244	1,238	1,356	1,206	1,293
Woods	3,224	3,363	3,395	3,687	3,297	3,494
Woodward	6,169	6,558	6,497	7,196	6,313	6,819

Table D2 : County Results of Irrigated Agriculture Demand Scenarios in AFY

County	Baseline		Hot/Dry		Warm/Wet	
	2030	2060	2030	2060	2030	2060
Adair	1,518	2,203	1,705	2,671	1,556	2,288
Alfalfa	5,940	7,285	6,625	8,520	6,073	7,515
Atoka	1,666	2,339	1,891	2,856	1,715	2,421
Beaver	34,538	37,383	37,909	43,869	35,351	38,768
Beckham	8,718	8,718	9,209	9,791	8,630	8,760
Blaine	6,517	6,517	7,548	7,416	6,587	6,688
Bryan	17,536	18,178	18,112	19,158	17,650	17,908
Caddo	37,078	45,228	42,651	51,809	36,508	44,698
Canadian	6,818	7,482	7,513	8,482	6,915	7,643
Carter	2,812	2,918	2,951	3,167	2,850	2,964
Cherokee	1,644	1,859	1,843	2,249	1,684	1,930
Choctaw	1,154	1,597	1,306	1,942	1,188	1,653
Cimarron	73,517	90,606	80,220	105,653	75,532	94,342
Cleveland	1,571	2,178	2,585	2,626	1,608	2,260
Coal	643	650	703	885	649	658
Comanche	3,089	3,688	3,305	4,133	3,118	3,734
Cotton	793	1,110	823	1,180	800	1,119
Craig	1,128	2,599	1,264	3,140	1,155	2,699
Creek	433	560	492	744	454	594
Custer	4,957	5,232	5,640	6,055	5,022	5,368
Delaware	949	949	1,064	1,148	973	986
Dewey	4,752	4,752	5,325	5,556	4,872	4,924
Ellis	27,870	35,263	30,704	41,404	28,474	36,462
Garfield	6,029	6,029	7,124	7,436	6,193	6,249
Garvin	2,298	3,734	2,491	4,303	2,328	3,810
Grady	11,291	11,291	12,171	12,827	11,378	11,328
Grant	1,801	1,801	2,116	2,182	1,833	1,853
Greer	10,445	17,016	11,348	19,646	10,692	17,637
Harmon	27,927	30,137	30,325	34,743	28,651	31,378
Harper	11,759	13,813	12,897	16,211	12,017	14,286
Haskell	3,006	3,633	3,378	4,410	3,080	3,772
Hughes	5,360	8,474	6,201	10,242	5,483	8,796
Jackson	105,813	111,960	114,874	128,722	108,595	116,808
Jefferson	427	523	479	630	436	369
Johnston	2,344	3,662	2,577	4,291	2,407	3,777
Kay	4,690	4,690	5,114	5,393	4,763	4,804
Kingfisher	8,716	9,902	10,949	11,827	8,897	10,205
Kiowa	4,813	5,190	5,355	6,008	4,929	5,380
Latimer	1,846	3,344	2,090	4,068	1,900	3,460
Le Flore	9,985	9,985	14,423	11,609	10,190	9,606
Lincoln	3,575	3,575	4,134	4,513	3,792	3,826
Logan	1,991	1,991	2,216	2,396	2,048	2,071
Love	3,695	5,133	4,134	6,258	3,780	5,276
Major	13,122	13,254	14,746	15,431	13,392	13,682

Table D2 : County Results of Irrigated Agriculture Demand Scenarios in AFY

County	Baseline		Hot/Dry		Warm/Wet	
	2030	2060	2030	2060	2030	2060
Marshall	4,952	5,397	5,243	5,943	5,029	5,505
Mayes	1,411	1,735	1,586	2,105	1,446	1,802
McClain	2,969	3,120	3,266	3,409	2,992	3,159
McCurtain	1,756	3,105	1,971	3,731	1,802	3,210
McIntosh	685	690	838	820	700	717
Murray	332	765	356	871	333	774
Muskogee	8,882	8,882	12,331	10,575	9,077	9,229
Noble	1,223	1,223	1,379	1,486	1,244	1,255
Nowata	616	1,148	692	1,568	630	1,187
Okfuskee	2,267	2,836	2,694	3,881	2,318	2,937
Oklahoma	5,537	5,537	5,733	5,878	5,599	5,614
Okmulgee	1,250	1,250	1,392	1,628	1,279	1,299
Osage	843	1,302	954	1,734	877	1,373
Ottawa	598	795	667	951	612	825
Pawnee	179	317	196	383	183	328
Payne	1,344	1,360	1,408	1,464	1,367	1,386
Pittsburg	3,299	3,958	3,531	4,430	3,335	4,017
Pontotoc	3,284	5,657	3,614	6,637	3,375	5,830
Pottawatomie	2,639	3,628	3,046	4,193	2,711	3,768
Pushmataha	824	836	934	1,019	848	865
Roger Mills	9,296	9,342	10,039	10,686	9,461	9,602
Rogers	1,769	2,160	1,836	2,394	1,782	2,184
Seminole	1,847	2,624	2,136	3,316	1,959	2,809
Sequoyah	2,465	2,832	2,881	3,378	2,521	2,942
Stephens	3,564	5,564	4,011	6,752	3,644	5,652
Texas	202,385	206,393	221,205	240,005	208,035	215,269
Tillman	18,661	19,408	20,306	22,343	19,143	20,211
Tulsa	8,012	8,775	8,226	8,966	8,022	8,794
Wagoner	8,392	8,392	8,947	9,349	8,503	8,570
Washington	867	1,306	1,101	1,713	898	1,374
Washita	5,571	6,234	6,090	7,197	5,669	6,412
Woods	3,787	4,439	4,164	5,218	3,869	4,587
Woodward	8,026	8,026	8,921	9,404	8,209	8,315

Table D3: County Results of M&I and Irrigated Agriculture Demands Scenarios in AFY

County	Baseline		Hot/Dry		Warm/Wet	
	2030	2060	2030	2060	2030	2060
Adair	4,073	5,729	4,396	6,533	4,173	5,963
Alfalfa	6,822	8,197	7,553	9,518	6,975	8,462
Atoka	5,399	7,253	5,815	8,212	5,540	7,541
Beaver	35,291	38,172	38,702	44,735	36,121	39,589
Beckham	14,280	15,648	15,047	17,338	14,322	15,963
Blaine	9,434	10,159	10,617	11,398	9,571	10,474
Bryan	27,335	30,566	28,403	32,645	27,689	30,810
Caddo	40,656	49,120	46,409	56,050	40,170	48,744
Canadian	24,818	28,366	26,514	31,443	25,369	29,435
Carter	12,860	14,561	13,528	15,893	13,151	15,104
Cherokee	10,404	13,610	11,069	15,120	10,657	14,177
Choctaw	2,821	3,387	3,056	3,889	2,896	3,517
Cimarron	74,223	91,352	80,963	106,472	76,255	95,119
Cleveland	44,375	49,304	47,724	54,276	45,500	51,439
Coal	1,447	1,782	1,549	2,119	1,474	1,837
Comanche	21,807	24,065	22,938	26,291	22,274	24,910
Cotton	1,614	1,979	1,684	2,125	1,640	2,023
Craig	3,867	6,133	4,148	7,010	3,960	6,380
Creek	9,825	11,274	10,372	12,454	10,066	11,746
Custer	10,809	11,645	11,785	13,044	11,011	12,035
Delaware	6,334	8,326	6,735	9,238	6,487	8,674
Dewey	5,897	5,948	6,530	6,864	6,044	6,169
Ellis	28,600	35,993	31,473	42,205	29,222	37,222
Garfield	19,078	19,872	20,904	22,665	19,566	20,690
Garvin	7,312	9,045	7,768	10,107	7,468	9,348
Grady	17,139	18,006	18,337	20,191	17,374	18,334
Grant	2,553	2,595	2,911	3,057	2,603	2,681
Greer	11,494	18,119	12,448	20,845	11,766	18,782
Harmon	28,749	31,030	31,185	35,714	29,491	32,306
Harper	12,732	14,814	13,921	17,309	13,012	15,327
Haskell	4,655	5,875	5,115	6,867	4,770	6,113
Hughes	7,538	11,340	8,494	13,376	7,715	11,784
Jackson	110,943	117,550	120,253	134,799	113,843	122,615
Jefferson	1,234	1,389	1,326	1,573	1,263	1,271
Johnston	4,540	6,586	4,881	7,469	4,657	6,820
Kay	12,963	13,550	13,863	15,169	13,242	14,054
Kingfisher	12,246	14,477	14,676	16,861	12,513	14,976
Kiowa	6,101	6,541	6,706	7,479	6,246	6,785
Latimer	4,352	6,305	4,730	7,308	4,469	6,550
Le Flore	17,485	18,880	22,323	21,341	17,878	18,887
Lincoln	6,320	6,897	7,030	8,160	6,606	7,293
Logan	7,874	9,473	8,428	10,628	8,076	9,877
Love	9,150	11,631	9,866	13,342	9,372	12,048
Major	14,135	14,308	15,812	16,583	14,429	14,777

Table D3: County Results of M&I and Irrigated Agriculture Demands Scenarios in AFY

County	Baseline		Hot/Dry		Warm/Wet	
	2030	2060	2030	2060	2030	2060
Marshall	9,284	11,983	9,788	13,101	9,467	12,360
Mayes	7,938	9,935	8,457	11,087	8,129	10,345
McClain	8,397	10,520	8,988	11,517	8,557	10,878
McCurtain	6,441	8,204	6,888	9,275	6,602	8,520
McIntosh	3,752	4,892	4,067	5,415	3,842	5,099
Murray	3,548	4,824	3,742	5,308	3,630	5,007
Muskogee	19,780	20,603	23,793	23,375	20,235	21,434
Noble	3,038	3,177	3,297	3,639	3,104	3,296
Nowata	2,028	3,055	2,178	3,657	2,075	3,174
Okfuskee	3,764	4,453	4,268	5,644	3,850	4,619
Oklahoma	142,150	152,107	149,916	166,789	145,718	158,664
Okmulgee	13,666	15,895	14,443	17,599	13,989	16,540
Osage	9,719	11,374	10,297	12,758	9,958	11,854
Ottawa	6,517	7,864	6,900	8,703	6,673	8,193
Pawnee	2,998	3,891	3,161	4,292	3,066	4,045
Payne	16,015	18,405	16,903	20,220	16,402	19,174
Pittsburg	12,449	14,429	13,165	15,879	12,711	14,935
Pontotoc	9,880	12,879	10,567	14,547	10,139	13,366
Pottawatomie	9,487	11,590	10,270	12,927	9,733	12,078
Pushmataha	2,195	2,670	2,377	3,022	2,253	2,778
Roger Mills	9,922	9,968	10,697	11,370	10,102	10,253
Rogers	17,982	22,372	18,902	24,522	18,379	23,233
Seminole	4,849	5,885	5,303	6,893	5,038	6,214
Sequoyah	11,351	13,931	12,248	15,539	11,630	14,524
Stephens	12,430	14,855	13,338	16,905	12,734	15,337
Texas	207,898	214,635	227,012	249,054	213,686	223,852
Tillman	20,079	20,929	21,791	23,993	20,593	21,790
Tulsa	129,529	139,094	136,063	151,394	132,400	144,436
Wagoner	18,529	20,774	19,613	22,887	18,880	21,462
Washington	13,353	14,328	14,245	15,972	13,674	14,925
Washita	6,750	7,478	7,327	8,553	6,875	7,705
Woods	7,011	7,801	7,559	8,905	7,167	8,082
Woodward	14,194	14,583	15,419	16,601	14,522	15,134