Oklahoma Panhandle Agriculture and Irrigation
Panhandle Regional Economic Development Coalition, Inc.

Panhandle Regional WATER PLAN

December 2012

PREPARED BY

Duane Smith & Associates
Carollo Engineers, Inc.

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OKLAHOMA PANHANDLE AGRICULTURE AND IRRIGATION

PANHANDLE REGIONAL ECONOMIC DEVELOPMENT COALITION, INC.

PANHANDLE REGIONAL WATER PLAN

FINAL REPORT

December 2012

LICENSED PROFESSIONAL ENGINEER
THOMAS O.
CROWLEY
21073
12/17/12
OKLAHOMA

Duane Smith & Associates

carollo

100 NORTHEAST FIFTH STREET • OKLAHOMA CITY, OKLAHOMA 73104 • (405) 840-7785 • FAX (405) 840-7786

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PANHANDLE REGIONAL ECONOMIC DEVELOPMENT COALITION, INC.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

BACKGROUND

1.1 OVERVIEW

Water supply and use is critical to all residents and businesses in the Oklahoma Panhandle. In addition to meeting the daily needs of the region's citizens and industries, access to reliable water supplies is critical to maintaining the Panhandle as Oklahoma's most productive crop producing region and one of the country's foremost producers of key crops. As a result, water supply is closely interlinked with the economic productivity of the Panhandle.

Recently, Oklahoma Panhandle Agriculture and Irrigation (OPAI) partnered with the Panhandle Regional Economic Development Coalition Inc. (PREDCI) in an unprecedented collaboration to prepare a comprehensive evaluation of water use and water supplies in the Oklahoma Panhandle, along with water management strategies that will extend the life of the Ogallala Aquifer and provide continued economic growth and development. That partnership led to the development of this Panhandle Regional Water Plan (PRWP). The Panhandle Region, as defined for purposes of the PRWP, includes Cimarron, Texas, and Beaver Counties in their entirety.

Together, OPAI and PREDCI developed the following goals:

> *The Oklahoma Panhandle Water Planning Group will strive to develop strategies for the efficient utilization of water resources including water conservation, water re-use, augmentation, and other water management strategies to promote economic development and benefit the citizens and environment of the Panhandle of Oklahoma.*

The 2012 Update of the Oklahoma Comprehensive Water Plan (OCWP) recently completed by the Oklahoma Water Resources Board provides an assessment of water supply availability, projected demands for each water sector use through 2060. The OCWP Executive Report also includes several recommendations that could affect water management and supply availability that are crucial to the current and future economic vitality of the Panhandle.

The Panhandle of Oklahoma presents unique challenges and opportunities as it relates to water and its role in long-term economic development. The Panhandle region is projected to continue its position as the largest water use area of the state, while having a predominant reliance on groundwater for its water supplies in the future. It also provides a huge economic engine for the State of Oklahoma and the entire region with Texas County being one of the most productive agriculture counties in the country. As such, it requires special considerations and those who utilize the water or derive benefit from the economy it provides must be proactive and vigilant in planning for its future use and management.

Much of the area has observed declines in water levels. Recognizing the vital role of water in the Panhandle's economy and vitality, the agriculture community and other water users have implemented significant conservation measures and water reuse. Water use data and water level data suggest that water level declines are occurring less rapidly as a result.

There is broad-based support in the Panhandle to continue this work. For instance, while corn is a high water-use crop, it uses less water now than it did in the past thanks to drought-tolerant seed crop research. Better farming techniques have been a key element of reducing water demands, reflected in water use data published by the U.S. Geological Survey (USGS) data. As we look to the future and keep the economy improving, we must continue to invest in these efforts. As water levels decline at a slower rate, we will examine the use alternative crops that use less water and provide economic stability. In fact, some areas of Beaver County have actually seen an increase in water levels.

Panhandle farmers have already taken steps to preserve and extend the life of the aquifer, investing in conservation, and these programs must continue. Increased regulatory programs would not be expected to meet the goals of the Panhandle Regional Water Planning Group, but more financial and technical assistance can be key to finding new ways to extend the life of the aquifer in economically viable ways. Programs such as the County Conservation Districts' cost share programs and the councils of government (COGs) are helping users conduct planning in ways that are proactive for saving water.

OPAI and PREDCI play a key role in shaping the region's water future. Since OPAI was formed, it has supported research and development, conservation, and less regulation. PREDCI is pivotal in bringing all the economic interests together to facilitate information sharing and informed decision making regarding the future of the Panhandle.

1.2 THE PLANNING PROCESS

As a part of framing any water plan process, it is important to understand from stakeholders what they believe to be the primary issues. Therefore, this water plan effort used facilitated discussions with user groups and stakeholders across the Panhandle to ascertain pertinent issues.

This process began with the formation of a Steering Committee made up of members of OPAI and members of PREDCI. The Steering Committee approved a workplan that entailed a series of stakeholder and user group meetings. These meetings culminated with a public meeting for discussion and development of final recommendations to be included in the PRWP.

The planning process included technical evaluations that detail the availability of water supplies in the Panhandle and projections of Panhandle water use through 2060, including residential and industrial use, crop irrigation and other agricultural uses, oil and gas use, and other demands. The technical evaluations also consider water conservation and reuse opportunities, and assess the economic implications of alternative crop mixes, irrigation technologies, and other strategies that have been considered in the OCWP and other water planning forums. In particular, the PRWP considers questions like "How could we build on existing water use efficiencies to increase the economic potential associated with water?"

Together, these technical evaluations form the foundation for the discussion of water management strategies that will help achieve the long-term water and economic goals for the Panhandle region.

1.3 REPORT OVERVIEW

This report is organized into three chapters, starting with this introduction chapter. Chapter 2 examines water supply availability, projections of water demand in the three Panhandle counties, projected water supply shortages, and an assessment of alternative water demand scenarios. Building on that information, Chapter 3 assesses water management strategies for the Panhandle toward meeting the long-term water management and economic goals for the region.

OKLAHOMA PANHANDLE WATER SUPPLIES AND DEMANDS

The Panhandle region's water supplies, projected water demands, and potential water supply shortages provide a foundation for the development and evaluation of water management strategies for the region. This chapter provides an overview of those projections. Given the significant role of irrigated agriculture in the Panhandle's economy and water use, this section also includes an assessment of the impacts of potential alternative crop irrigation technologies and crop mixes on the economic output of irrigated agriculture in the region.

Much of the information in this section is adapted from the recently completed 2012 Oklahoma Comprehensive Water Plan (OCWP 2012). The 2012 OCWP was developed by the Oklahoma Water Resources Board (OWRB) in partnership with the U.S. Army Corps of Engineers (USACE) and several other state and federal agencies. The 2012 OCWP presents data and analyses on a watershed or "basin" level, by dividing the state into 82 basins and aggregating those basins into 13 Watershed Planning Regions. Many of the technical analyses for the OCWP (e.g., water demand projections) were first developed at the county level, then allocated to the 82 basins.

As noted in Chapter 1, the Panhandle Region, as defined for purposes of this PRWP, includes Cimarron, Texas, and Beaver Counties in their entirety. In contrast, the watershed-based Panhandle Region analyzed in the 2012 OCWP includes those three counties plus Harper County and portions of Woods, Woodward, Major, Blaine, Dewey, and Ellis Counties.

Where possible, OCWP data were referenced from county-level calculations. For watershed-based information, OCWP Basins 55 and 66 are the watersheds most directly overlying Cimarron, Texas, and Beaver counties. OCWP Basins 55 and 66 account for more than 75 percent of the demand in Cimarron, Texas, and Beaver counties.

2.1 PANHANDLE WATER SUPPLIES

This section provides an overview of the Panhandle water supplies, groundwater recharge rates, and surface water flows. Water sources are categorized into three types (OCWP 2012), including:

- Alluvial groundwater: water found in an aquifer with porous media consisting of loose, unconsolidated sediments deposited by fluvial (river) or aeolian (wind) processes, typical of riverbeds, floodplains, dunes, and terraces.
- Bedrock groundwater: water found in an aquifer with porous media consisting of lithified (semi-consolidated or consolidated) sediments, such as limestone, sandstone, siltstone, or fractured crystalline rock.

- Surface water: water in streams and waterbodies as well as diffused over the land surface.

Water use in the Oklahoma Panhandle is characterized by minimal surface water and alluvial groundwater supplies, and significant bedrock groundwater resources. Alluvial groundwater is hydraulically connected to surface water, and therefore reflects its relatively scarce availability and use in the Panhandle.

As shown in Figure 2.1, surface water and alluvial groundwater is used to meet less than 2 percent of the region's demand, with the vast majority of demand being supplied by bedrock groundwater from the Ogallala aquifer.

2.1.1 Groundwater Use and Water Level Trends

The Ogallala bedrock aquifer has a substantial volume of groundwater in storage. Historically, the aquifer has provided ample water supplies to the region, but declining water levels in many parts of the Panhandle and surrounding states show the effect of continued use in excess of recharge rates. A comparison of recharge rates to projected demands in the OCWP indicated that aquifer storage depletions are likely to occur throughout the year, and will be largest in the summer months. These depletions are small relative to the amount of water in storage, but over time are expected to lead to adverse impacts on groundwater levels, pumping costs, yields, and possibly water quality.

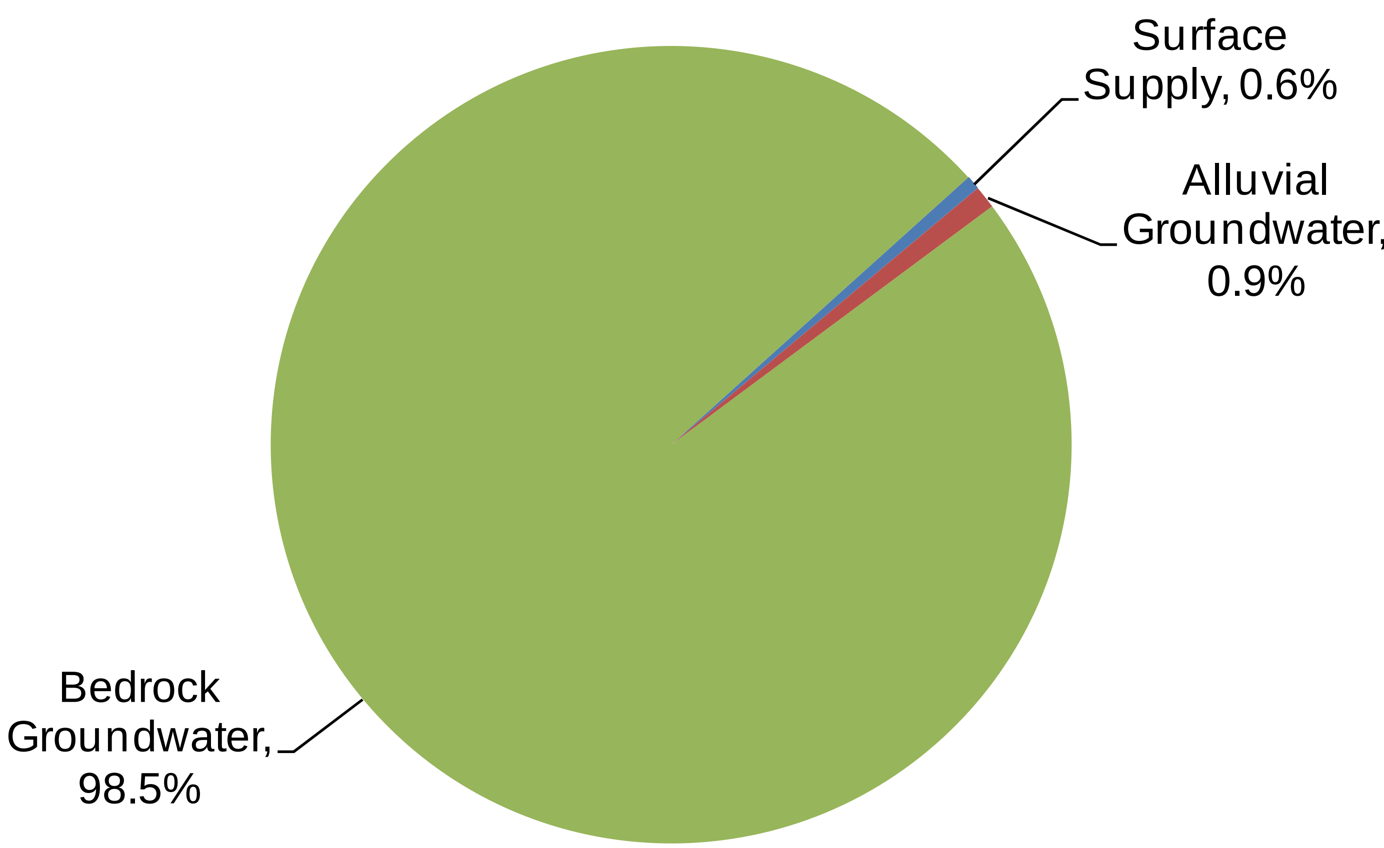
As shown in Figure 2.2, the last 60 years have seen increased use of the Ogallala aquifer in the Panhandle counties. The advent of flood irrigation systems led to significant increases in groundwater use in the late 1960s and 1970s, then tapering off as efficiencies increased.

Following applicable statute and policy, OWRB issues permits for use of the Ogallala aquifer in the Panhandle using an equal proportionate share of 2 acre-feet per year (AFY) per acre of dedicated land. While historical pumping was highest in the 1970s, groundwater pumping has remained in excess of recharge rates, resulting in declining groundwater levels in many areas. Recharge and storage capacity for the portion of the Ogallala aquifer underlying each county are detailed in Table 2.1.

Table 2.1 Ogallala Aquifer Recharge and Storage

County	Recharge Rate (AFY)	Recharge Rate (inches/year)	Aquifer Storage Volume (AF)
Cimarron	15,100	0.4	10,367,000
Texas	10,600	0.3	40,390,000
Beaver	8,900	0.3	24,047,000
Total	**34,600**	**N/A**	**74,804,000**

Notes:
(1) Source: OCWP Physical Water Supply Availability Report (OWRB, April 2011).



ESTIMATED USE OF PANHANDLE SUPPLY SOURCES

FIGURE 2.1

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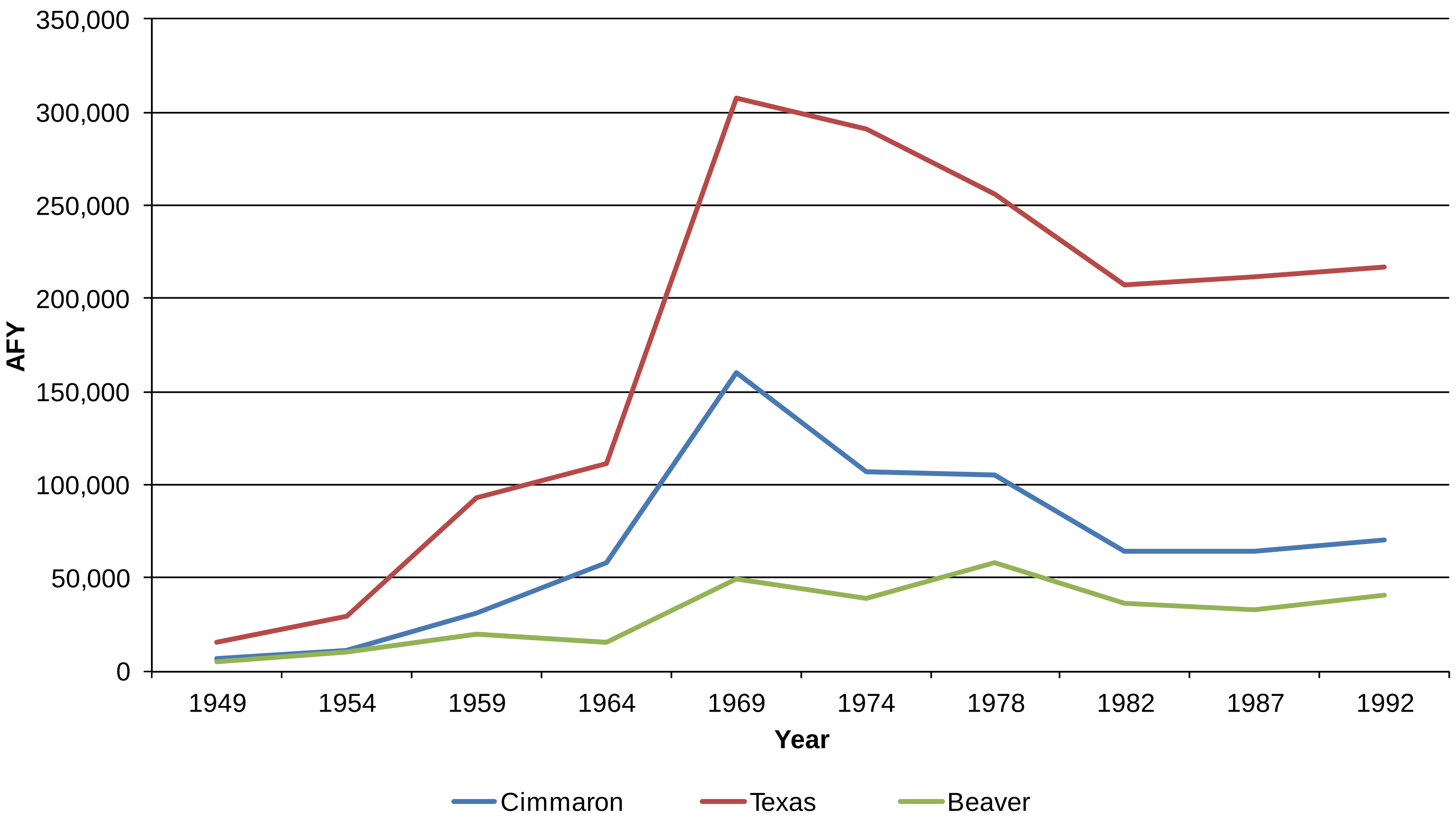

HISTORICAL OGALLALA AQUIFER USE (USGS 1999/2007)

FIGURE 2.2

OKLAHOMA PANHANDLE AGRICULTURE AND IRRIGATION
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As shown in Table 2.1, total storage of the Ogallala aquifer is significant, amounting to approximately 75 million acre feet (AF) in the Panhandle alone. However, due to limited precipitation combined with rocky and impermeable surfaces overlying much of the aquifer, the annual recharge is fairly limited. As shown in Table 2.1, the annual natural recharge rate is approximately 35,000 AFY total in the three counties. This total recharge amount is approximately equivalent to the operating safe yield of the basin in these counties, not accounting for subsurface flows in and out of the counties. Hence, when groundwater pumping exceeds 35,000 AFY over a prolonged period of time, groundwater levels, and total volumes in storage will decline. Localized effects of well pumping are often more significant.

The USGS conducted a study in 1999 that projected groundwater level changes in the Oklahoma Panhandle and surrounding states through year 2020. Pumping rates used in the study included values very similar to updated demand projections for all users in the three counties summarized in Section 2.2 of this PRWP (70,000 AFY in Cimarron County, 224,000 AFY in Texas County, and 40,000 AFY in Beaver County), The results, shown in Figure 2.3, projected that water levels in the Ogallala aquifer would continue to decline, with pumping in excess of recharge rates.

The study predicted declines in Texas County over the 1998-2020 study period of 10 to 50 feet, while groundwater levels in Cimarron and Beaver County were projected to drop between 10 and 25 feet over that same period.

The OWRB's Water Well Level Mass Measurement Network includes more than 500 water wells statewide, which are measured each year for depth to water. A significant portion of these wells are in the Panhandle. Data for any well in the program can be accessed, charted, and downloaded from the OWRB's website at http://www.owrb.ok.gov/supply/drought/dr8_groundwater.php. An inspection of OWRB Mass Measurement well level graphs (dating in many cases back to the 1960s or earlier) supports the conclusion that water levels are declining in many areas of the Panhandle at rates similar to those predicted in the 1999 USGS study.

2.1.2 Surface Water Resources

The 2012 OCWP Panhandle Watershed Planning Region Report provides information on surface water resources as follows:

> Surface water has historically been only a small fraction of the supply used to meet demand in the Panhandle Region. The region's major streams include the upper North Canadian River (known in part of the region as the Beaver River) and the upper Cimarron River. Historically, rivers and creeks in the region have had periods of low to no flow during each month of the year due to seasonal and long-term precipitation trends. Irrigation has had a significant effect on the Beaver River's stream flow, which has decreased substantially since the 1970s. Optima Lake, the

only major reservoir in Cimarron, Texas, and Beaver Counties, was built in 1978 and operated by the U.S. Army Corps of Engineers. It regulates flow in the Beaver River but does not sustain a water supply yield. Surface water in the region is fully allocated, limiting diversions to existing permitted amounts.

The median flow over the period of record in the Beaver River at Beaver is about 1,400 AF/month in summer, but only 10 AF/month in fall. However, the river can have prolonged periods of low to no flow in any month of the year. If the effects of irrigation persist, the median flow is expected to decrease in the future. The Cimarron River flows through the northwest portion of Cimarron County. No major flow gages are available to provide a long-term record of flow in this reach of the river.

These rivers have not historically been used as a significant source of supply in the Panhandle region. Seasonal stream flow fluctuations in the Panhandle region are presented in Figure 2.4. Because surface water is already fully allocated for permits in the Panhandle, no significant increase in use of surface water resources is projected for the region.

As shown in Figure 2.4, stream flow in the Panhandle fluctuates seasonally with the majority of annual flows taking place over a few months in late spring or summer. These trends are well established, with the values shown above representing stream gauge averages over the last 20 to 60 years. On a yearly basis, actual monthly values are quite variable and often drop below 1 percent of average annual flow for a month. This extreme variability further constrains the use of surface water as a source of water for the region.

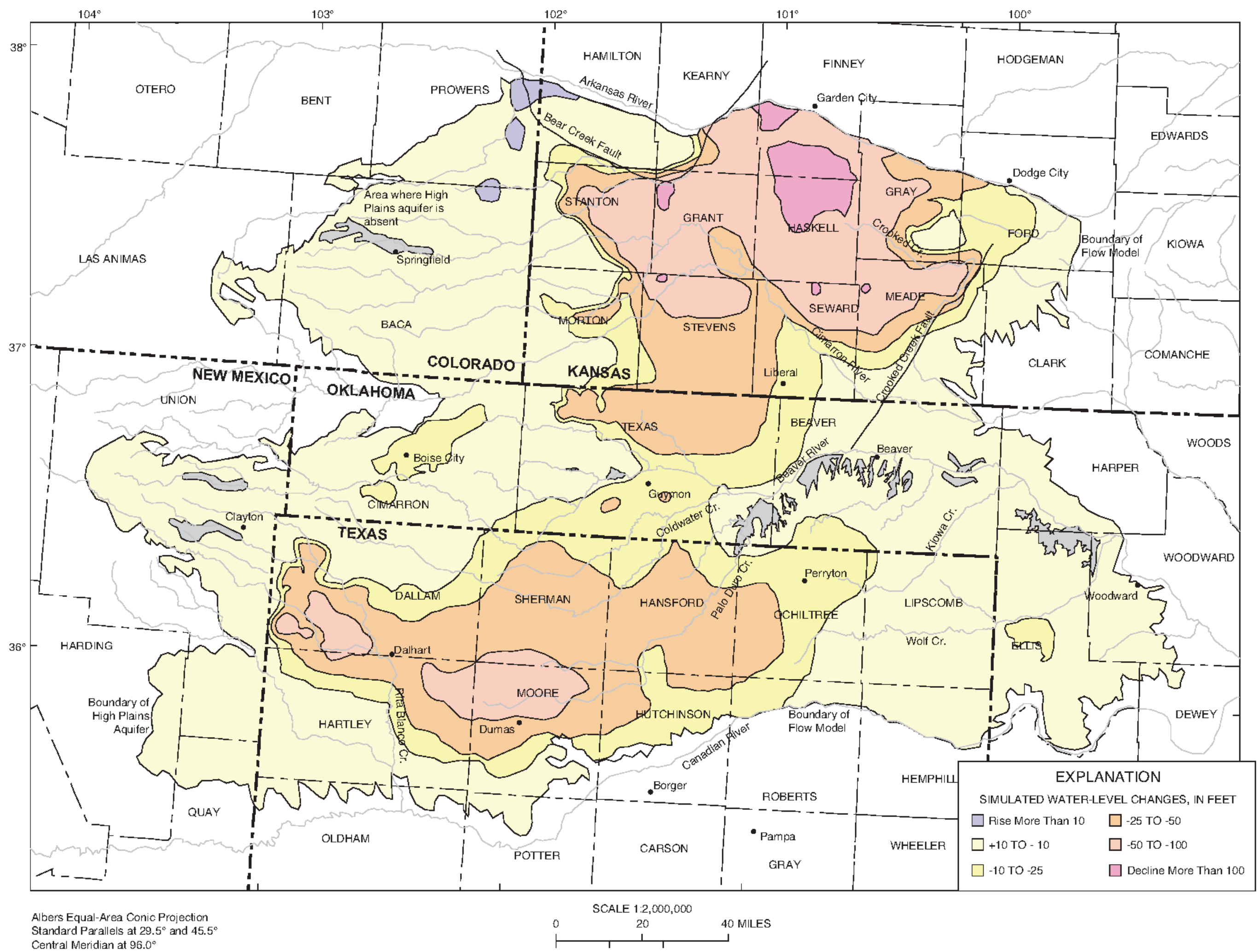
Figure 2.5 provides an excerpt of flow data from the OCWP Panhandle Watershed Planning Region Report for the Beaver River at Beaver, further demonstrating the variability and limitations on supply availability.

2.1.3 Panhandle Water Supply Summary

The Panhandle Region relies primarily on bedrock groundwater from the Ogallala aquifer. It is anticipated that the Ogallala aquifer will remain the primary source of water for the region in the future, as surface water and alluvial groundwater supplies are insufficient in quantity and too intermittent to reliably meet demand.

2.2 WATER DEMAND PROJECTIONS

This section provides an overview of the Panhandle water demands and includes a discussion of the demand projections by county, by water use type or “sector,” and by public water provider (for the larger community water systems) in the Panhandle. The potential for increased water reuse and water conservation are also discussed.



PROJECTED GROUNDWATER LEVEL CHANGES 1998-2020 (USGS 1999)

FIGURE 2.3

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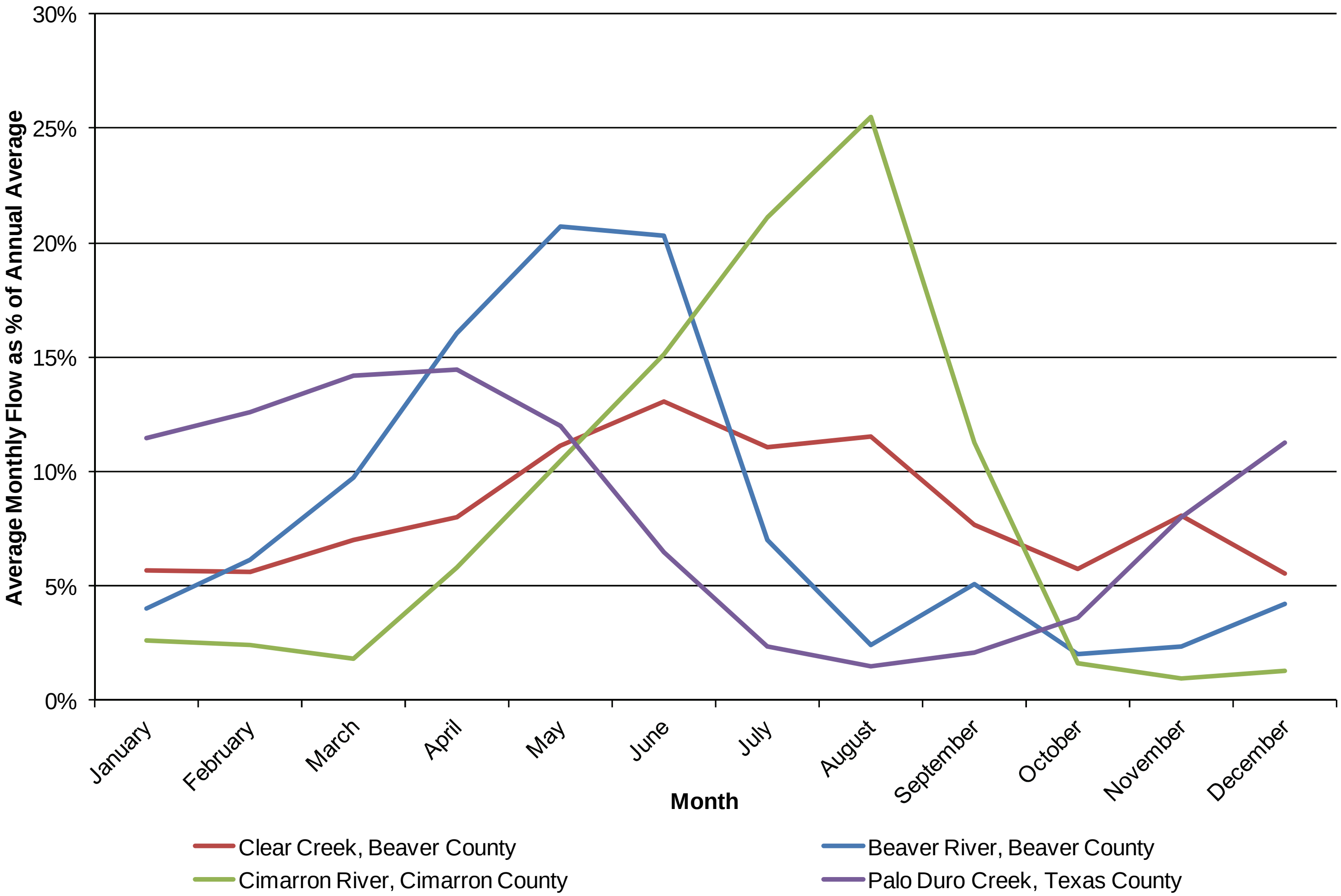

MONTHLY DISTRIBUTION OF STREAM FLOW 1965-2010

FIGURE 2.4

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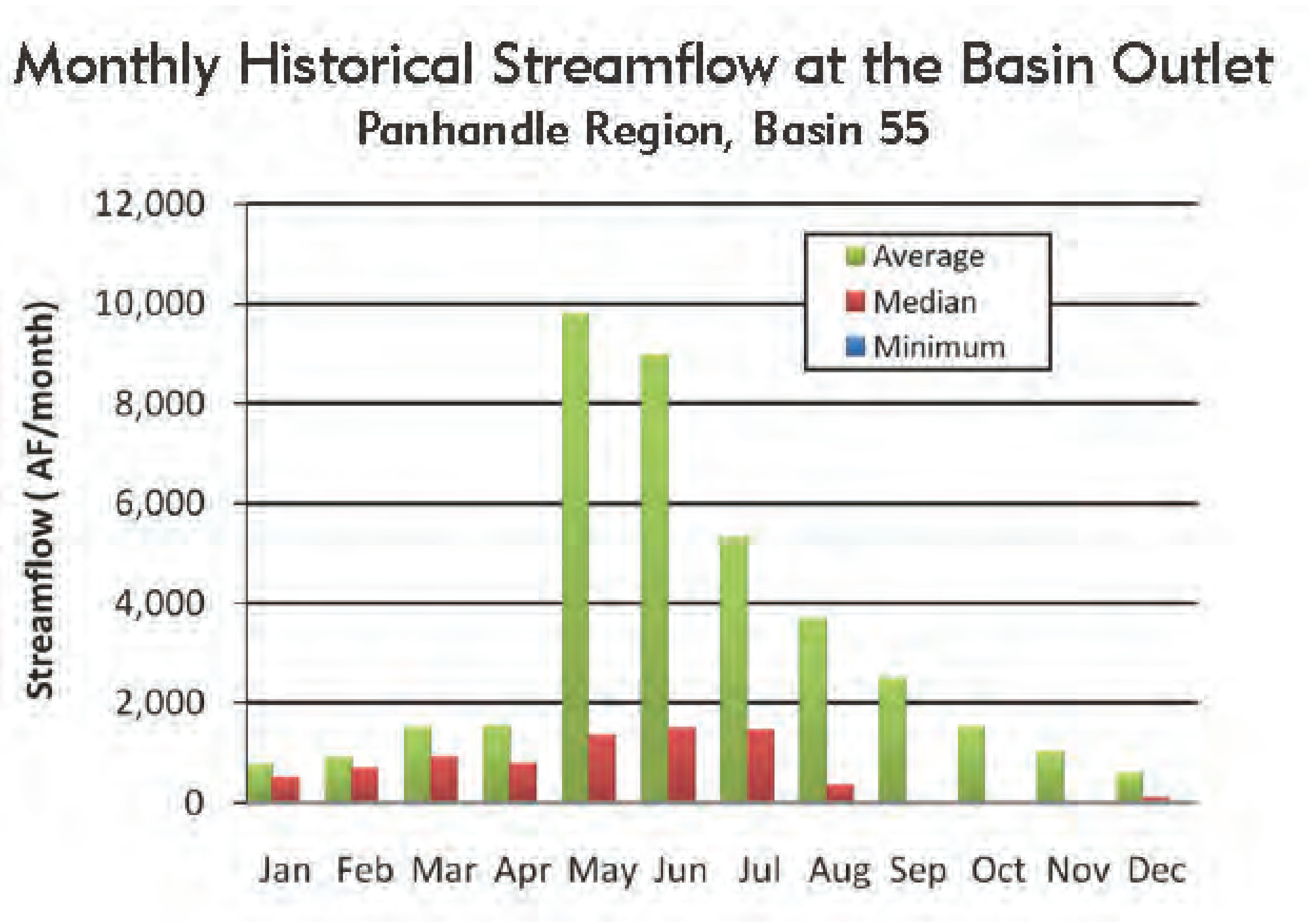

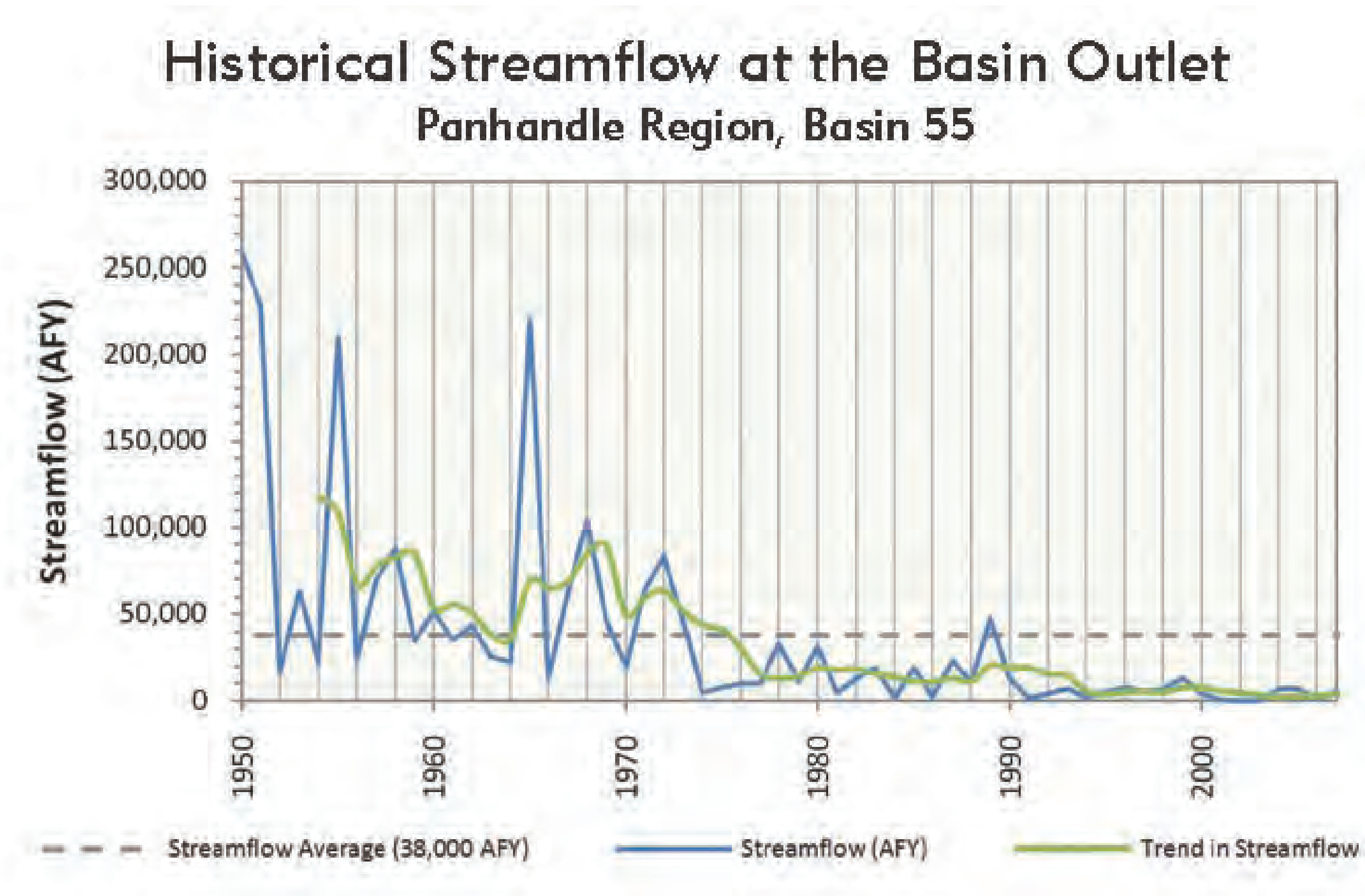

STREAMFLOW DATA FOR THE BEAVER RIVER AT BEAVER (OCWP 2012)

FIGURE 2.5

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2.2.1 Demand Projections by County

Water demand refers to the amount of water required to meet the needs of people, communities, industry, agriculture, and other users. Increases in water demand typically correspond to growth in population and economic activity. The 2012 OCWP developed water demand projections through 2060 for seven different water demand sectors in each county in Oklahoma, before allocating those demands to the OCWP planning basins.

For the PRWP, the OCWP was used as the initial basis of demand projections. However, crop irrigation demand projections were modified from the OCWP values for Cimarron County, based on input received from the PRWP Steering Committee as described in Section 2.2.2. The resulting PWRP demand projections for Beaver, Cimarron, and Texas Counties are shown in Table 2.2.

Table 2.2 Panhandle Demand Projections by County

County	Demand (AFY)					
	2010	2020	2030	2040	2050	2060
Beaver County	37,846	39,173	40,524	41,923	43,149	44,865
Cimarron County	65,080	65,198	65,291	65,356	65,456	65,559
Texas County	224,653	227,314	232,447	237,694	242,743	248,480
Total	**327,579**	**331,685**	**338,262**	**344,973**	**351,348**	**358,904**

Notes:
(1) Adapted from OCWP 2012 as described in this section.

2.2.2 Demand Projections by Water Use Sector

The projected Panhandle demands broken down by water use sector are displayed in Table 2.3. This includes the same water use sectors described in the OCWP, except Thermoelectric Power generation because there are no thermoelectric power plants in the three counties.

Table 2.3 Panhandle Demands by Water Use Sector

Demand Sector	Demand (AFY)					
	2010	2020	2030	2040	2050	2060
Public Supply Non-Resident	1,341	1,444	1,655	1,862	2,072	2,280
Public Supply Residential	3,838	4,580	5,316	6,035	6,772	7,497
Self Supplied Residential	1,052	1,168	1,275	1,371	1,478	1,583
Crop Irrigation	294,480	296,764	299,048	301,332	303,085	305,901

Table 2.3 Panhandle Demands by Water Use Sector						
	Demand (AFY)					
Demand Sector	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Livestock	14,135	14,314	14,493	14,672	14,851	15,030
Oil and Gas	1,633	2,410	3,353	4,462	5,736	7,176
Self Supplied Industry	11,100	11,006	13,122	15,238	17,354	19,437
Total	**327,579**	**331,685**	**338,262**	**344,973**	**351,348**	**358,904**

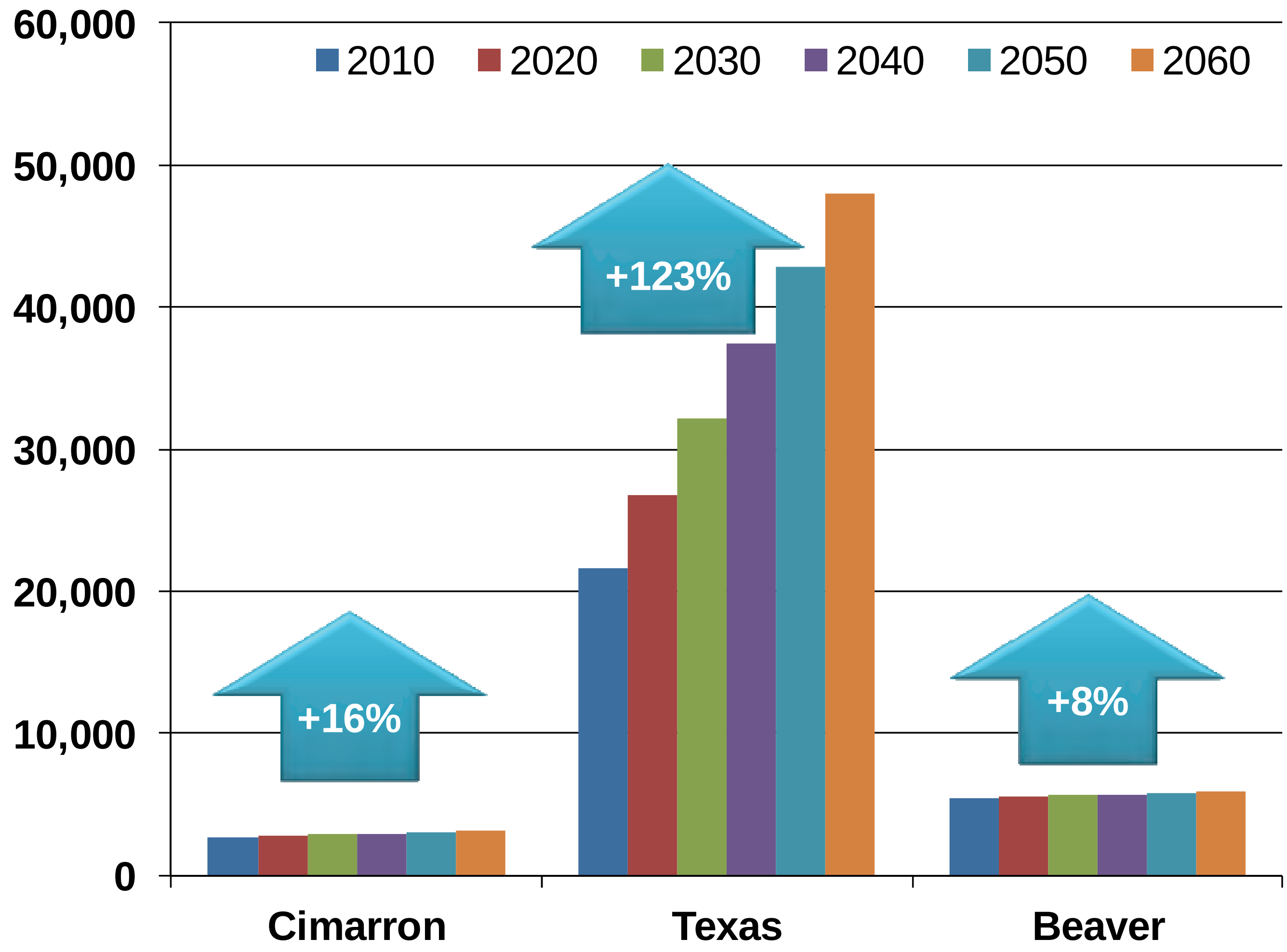
Notes:
(1) Adapted from OCWP 2012 as described in this section.

These demand projections are based on the sources of data and assumptions described below.

Public water supply system demands (also referred to as Municipal and Industrial demands, or M&I) are a function of service area population and per-capita use. The OCWP referenced state demographer data showing significant increases in population in Texas County, and slower growth in Cimarron and Beaver Counties (Figure 2.6). System losses are also factored into the demands, including 10 percent in Beaver County, and 15 percent in Cimarron and Texas counties. OCWP per-capita demands and system losses were based on OCWP surveys conducted in 2008 and 2010. For Beaver, Cimarron, and Texas counties, the per-capita demands used to calculate public water supply demands were 118, 269, and 117 gallons per capita day (gpcd), respectively. These values vary significantly from one county to another, depending on whether there are major industries or other water use drivers that reflect the customer base in the county's public water supply systems.

Self-supplied residential demands include residential use for people not served by a public water supply system. Demands are estimated by using the self-supplied population in combination with the county's average gallons per capita day demand factor.

Demands for the crop irrigation sector were calculated by taking the weighted average crop irrigation requirement (CIR) and standard field application efficiency factor for each county, and multiplying these data by the total irrigated acres in the county. The OCWP used National Agricultural Statistics Service (NASS) data and 2007 Agricultural Census data to estimate crop irrigation demands. The countywide weighted CIR is a function of the crop mix for irrigated acres in the county and each crop's water needs under Panhandle climate conditions. For Beaver, Cimarron, and Texas counties, the resulting baseline weighted CIR for 2007 (per the OCWP) is 0.95 acre feet per acre (AF/ac), 1.12 AF/ac, 1.07 AF/ac, respectively. The irrigation efficiency is a function of the type of irrigation equipment in use. The irrigation efficiency in all three counties was estimated based on 2005 USGS data regarding irrigation equipment in use in each county and national literature values for the efficiency of each type of irrigation equipment (see Section 2.5.1).



POPULATION PROJECTIONS BY COUNTY THROUGH 2060 (OCWP 2012)

FIGURE 2.6

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The OCWP evaluated historical numbers of irrigated crop acres in each county, using historical Ag Census data. Because it can be difficult to predict future irrigation amounts, the OCWP took a statewide approach that conservatively assumed that the historical maximum irrigated acres (1977-2007 or 1987-2007, depending on data availability) would be the same as the number of irrigated acres in each county in 2060. The number of irrigated acres was then assumed to increase linearly between the 2007 actual number of irrigated acres and the 2060 maximum number of irrigated acres. Feedback from the PRWP Steering Committee suggested that this approach is not appropriate for Cimarron County, where decreases in irrigated acres are anticipated due to groundwater level declines and supply availability issues, which are already causing some areas to come out of irrigated production. Because the rate of removal of acreage from irrigated production could not be calculated accurately, the PRWP instead assumes that the number of irrigated acres in Cimarron County will remain constant at 2007 levels; it is acknowledged that irrigated acres and crop irrigation demands could thus be lower than shown here. The resulting estimates of irrigated acres used for PRWP crop irrigation demand projections are shown in Table 2.4.

Table 2.4 Assumed Irrigated Acreage for Crop Irrigation Demand

County	Irrigated Crops (ac)					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Cimarron	46,800	46,800	46,800	46,800	46,800	46,800
Texas	156,340	157,386	158,431	159,477	160,280	161,569
Beaver	28,763	29,598	30,434	31,269	31,910	32,940
Total	**231,903**	**233,784**	**235,665**	**237,546**	**238,990**	**241,309**

Notes:
(1) Adapted from OCWP 2012 as described in this section.

For livestock demand, standard daily animal requirements were combined with county level livestock statistics from the 2007 Census of Agriculture to develop an annual water demand. Similar to the OCWP crop irrigation method, the historical maximum head count for a given animal type was assumed to be the 2060 head count, summarized in Table 2.5.

Table 2.5 OCWP 2060 Animal Count for Livestock Demand						
	Animal Type					
County	Cattle (excl. dairy)	Dairy Cows	Sheep	Hogs	Chickens	Horses
Cimarron	134,887	2,318	445	32,309	174	533
Texas	282,969	276	1,294	1,145,999	701	2,409
Beaver	120,597	430	729	332,088	403	1,107
Notes: (1) Source: OCWP 2012.						

OCWP oil and gas demands were developed for shale drilling, conventional drilling, and unconventional drilling using drilling forecasts and water use rates provided by industry representatives. For self-supplied industrial demands, the OCWP examined 30 large industrial companies to complete the projected demands for the Panhandle.

As shown in Table 2.3, the largest demand sector in the Panhandle is crop irrigation. Furthermore, demand in each sector is projected to increase over the next 50 years. Crop irrigation demands are projected to grow at an annual rate of 0.1 percent, slightly slower than the growth in overall Panhandle Region demands (0.2 percent annually).

The supply sources used to meet Panhandle demands vary based on sector. Crop irrigation, for example, is almost exclusively supplied by bedrock groundwater from the Ogallala Aquifer. The projected supply sources for the Panhandle through 2060 are shown below in Table 2.6. Because surface water is already fully allocated in the Panhandle for permits, growth in surface water use would have to be accomplished through increasing the utilization of existing permits.

Table 2.6 Projected Use of Panhandle Supply Sources						
	Demand (AFY)					
Supply Source	2010	2020	2030	2040	2050	2060
Surface Water	133	181	237	302	375	457
Alluvial Groundwater	3,158	3,194	3,230	3,266	3,296	3,338
Bedrock Groundwater	324,287	328,311	334,794	341,404	347,676	355,109
Total	**327,578**	**331,686**	**338,262**	**344,972**	**351,348**	**358,904**

As shown in Table 2.6, bedrock groundwater is assumed to continue to supply approximately 98 percent of the water to the Panhandle, as it is essentially the only source of water that is reliably available to users in the Panhandle.

2.2.3 Public Water Supply System Demand Projections by Provider

The OCWP developed demand projections for over 800 of the largest public water supply providers in the state, using provider input gained from surveys conducted in 2008 and 2010. OCWP demand projections for many of the Panhandle region water providers are shown in Table 2.7.

Table 2.7 Major Utility Supplier Demand Projections

County/Water Provider	Demand (AFY)					
	2010	2020	2030	2040	2050	2060
Beaver County						
Beaver	450	459	467	476	481	490
Beaver Co RWD #1 Turpin	79	80	82	83	84	86
Beaver Co RWD #2 Gate	16	16	17	17	17	19
Forgan	44	44	45	46	47	48
Cimarron County						
Boise City PWA	470	499	514	514	530	542
Keyes Utility Authority	101	106	110	110	113	118
Texas County						
Goodwell	181	224	268	312	358	402
Guymon	6,366	7,913	9,489	11,064	12,634	14,186
Hardesty Utilities	44	55	66	77	88	99
Hooker	603	750	900	1,049	1,199	1,346
Optima	24	30	36	42	47	54
Texas County RWD #1	45	55	66	78	89	99
Texhoma	285	355	425	495	566	636
Tyrone	282	351	422	494	562	631

Notes:
(1) Source: OCWP 2012.

As shown in Table 2.7, each of the public water supply providers listed is projected to have an increase in demands. The demands and increases in demand, however, are relatively small compared to the demands for the Panhandle region as a whole. Deviations from the projected population growth rates and/or the per-capita demands would alter the demand projections for individual communities.

2.2.4 Summary of Water Supplies and Demands

Surface water has historically been only a small fraction of the supply used to meet demand in the Panhandle Region. The region's major streams include the upper North Canadian (or Beaver) River and the upper Cimarron River. Rivers and creeks in the region can have periods of low to no flow during any month of the year, and are generally unreliable as a major source of supply. Optima Reservoir, the only major Panhandle reservoir, does not sustain a water supply yield. Alluvial groundwater, which is groundwater that is hydraulically connected to surface water sources, is also very limited in the region.

Bedrock groundwater from the Ogallala aquifer is the primary water supply source in the Panhandle. While historical pumping was highest in the 1970s, as shown in Figure 2.2, use rates have remained in excess of recharge rates resulting in declines in groundwater levels.

As shown in Figure 2.7, bedrock groundwater is expected to continue to comprise nearly 99 percent of the region's future water supply. However, declining groundwater levels will lead to shortages that need to be anticipated and addressed through water management strategies. Municipal conservation and reuse are discussed in Section 2.4; additional water management strategies are explored in Chapter 3 of this report.

Average demands for the Panhandle broken down by water use sector are depicted in Figure 2.8.

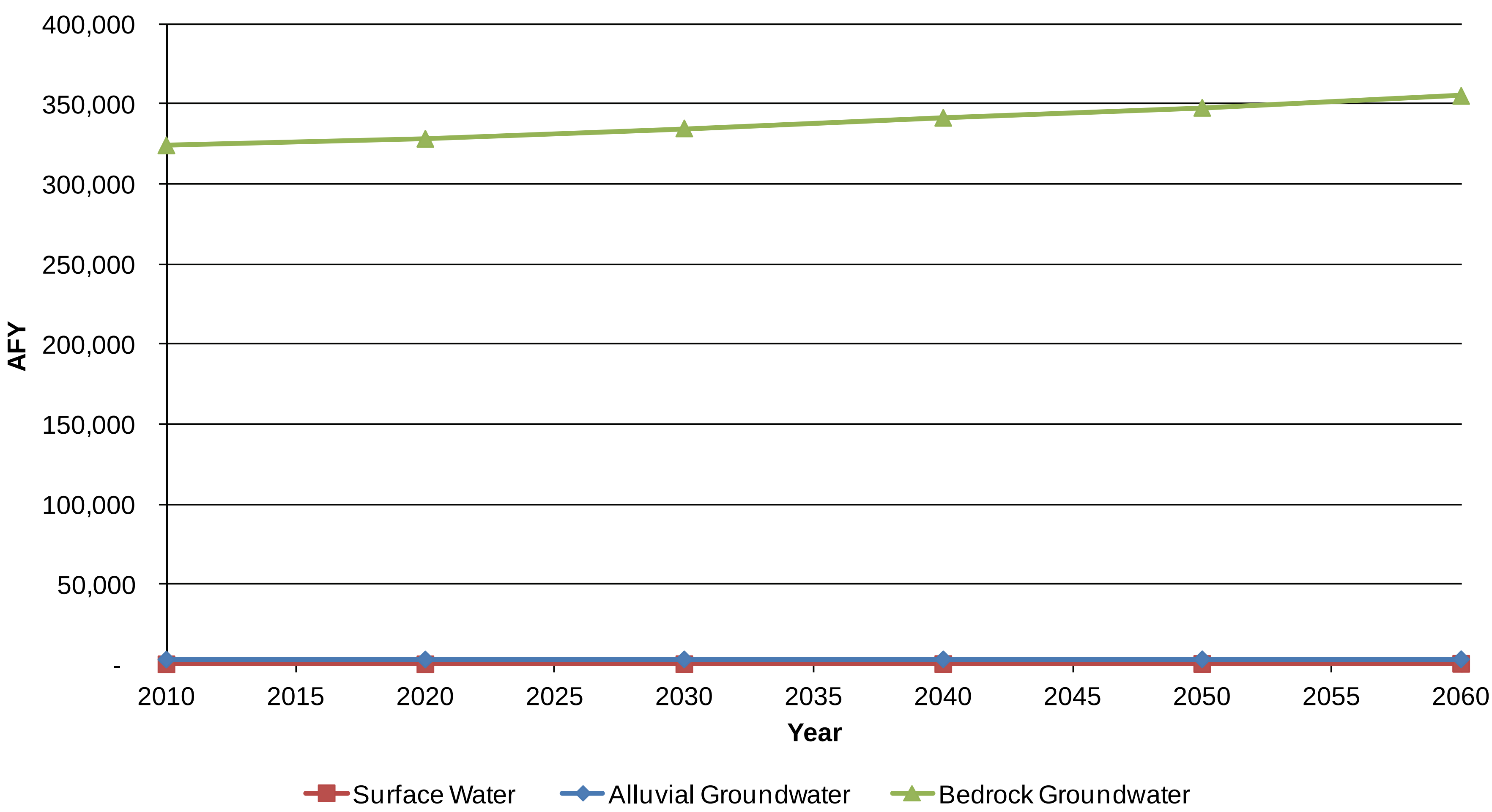
As shown in Figure 2.8, crop irrigation comprises the majority of demand in the Panhandle. Furthermore, the majority of these demands are from Texas County, the county with the highest agricultural production in the region. The breakdown of demand by Panhandle county is shown in Figure 2.9.

Figure 2.9 depicts average projected demand by county for Panhandle region demands. Texas County, with its high agricultural production, accounts for approximately two-thirds of all Panhandle demands.

2.3 WATER SUPPLY SHORTAGES

This section provides an overview of projected supply shortages in the Panhandle. Surface water supplies, alluvial groundwater supplies, and bedrock groundwater supplies are considered.

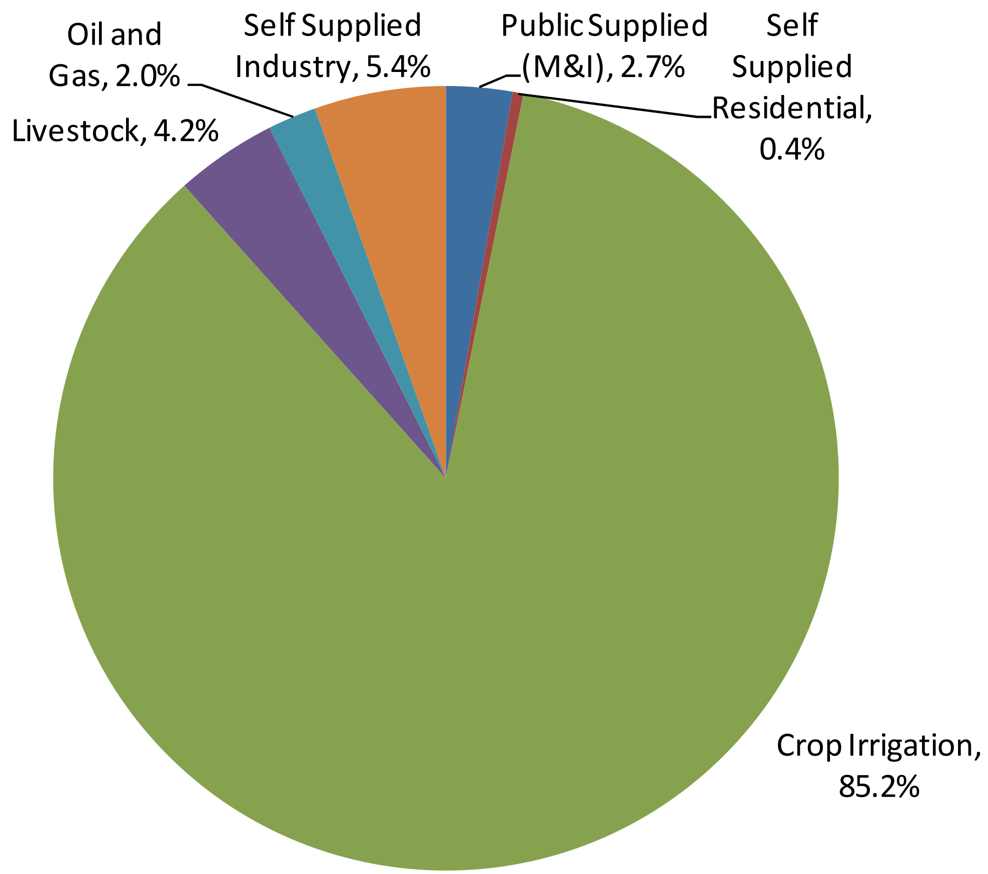
Surface water shortages can only be accurately estimated at stream gaging locations, where the total "supply" can be compared to demands on that resource. Therefore, this section includes information from the basin-level analyses conducted in the OCWP.



PROJECTED PANHANDLE SUPPLY SOURCES

FIGURE 2.7

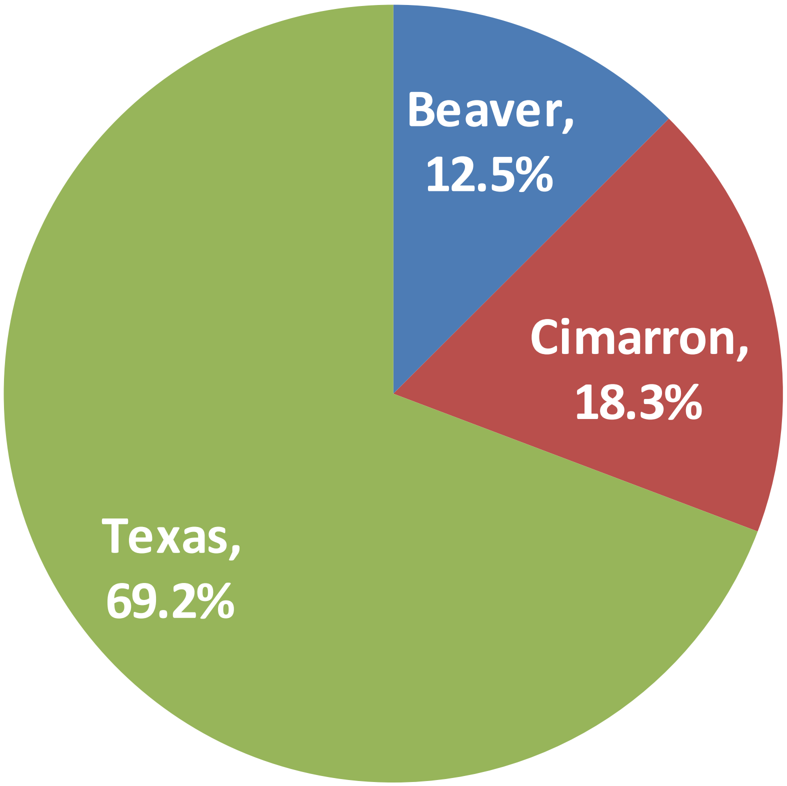
OKLAHOMA PANHANDLE AGRICULTURE AND IRRIGATION
PANHANDLE REGIONAL ECONOMIC DEVELOPMENT COALITION, INC.
PANHANDLE REGIONAL WATER PLAN



PERCENT OF TOTAL PANHANDLE DEMAND BY SECTOR, 2060

FIGURE 2.8

OKLAHOMA PANHANDLE AGRICULTURE AND IRRIGATION
PANHANDLE REGIONAL ECONOMIC DEVELOPMENT COALITION, INC.
PANHANDLE REGIONAL WATER PLAN



PERCENT OF TOTAL PANHANDLE DEMAND IN EACH COUNTY, 2060

FIGURE 2.9

OKLAHOMA PANHANDLE AGRICULTURE AND IRRIGATION
PANHANDLE REGIONAL ECONOMIC DEVELOPMENT COALITION, INC.
PANHANDLE REGIONAL WATER PLAN

A surface water “gap” occurs any time demands on a surface water resource exceed available flow in the stream. In contrast, the OCWP defined a groundwater “depletion” as occurring when demand on a given aquifer (bedrock or alluvial) will exceed its rate of recharge. As such, a groundwater depletion does not necessarily indicate that the demand could not be met, but instead indicates a situation where long-term continued use at the projected rates could over time reduce groundwater levels and thus become economically or physically infeasible over time.

This section summarizes the results of the OCWP water supply shortage analyses for OCWP Basins 55 and 66, which are representative of conditions anticipated throughout the Panhandle. Basins 55 and 66 include all of Texas and Cimmaron Counties and western portions of Beaver County. Minor differences between the shortages summarized in the OCWP and the actual expected shortages per the PRWP can also be anticipated, due to slightly lower demands projected for Cimarron County in the PRWP versus those shown in the OCWP.

2.3.1 Summary of Potential Water Supply Shortages

Based on projected water demands and historical hydrology, water shortages and groundwater storage depletions are projected to occur in the Panhandle. This region has already experienced water level declines in the Ogallala, with localized declines as much as 100 feet in Texas County to more than 50 feet in Cimarron County. The rate of drawdown is small compared to the significant amount of storage in the aquifer, and is expected to decrease as water use is reduced through conservation and reuse measures that have been implemented and continue to be expanded. However, localized storage depletions may adversely affect well yields, water quality, and pumping costs.

The magnitude (size) of water supply gaps projected for OCWP Basins 55 and 66 are shown in Table 2.8. The frequency of shortages (indicating how often they will occur) is also an important consideration in water supply planning. Surface water gaps will occur at least one month out of each year. By 2060, alluvial groundwater storage depletions from minor aquifers will also increase and occur in at least one month of nearly every year. In 2020, the OCWP estimated that there would be a 36 percent probability of surface water shortages in any given year, increasing to a 95 percent probability by 2060. Because bedrock groundwater recharges at a relatively constant rate (mostly independent of precipitation variability), bedrock groundwater depletions are expected to occur every year from now through the planning period. Bedrock groundwater depletions are expected to be at their highest rate in the summer months, when crop irrigation demands are highest.

Table 2.8 Magnitude of Projected Supply Gaps for OCWP Basins 55 and 66					
	Difference Between OCWP Demand and Streamflow or Recharge (AFY)				
	2020	**2030**	**2040**	**2050**	**2060**
Basin 55					
Surface Water gaps	30	90	180	200	320
Alluvial Groundwater Depletions	60	130	240	290	370
Bedrock Groundwater Depletions	7,510	17,010	26,940	35,590	47,100
Basin 66					
Surface Water Gaps	60	160	240	290	400
Alluvial Groundwater Depletions	0	0	0	20	20
Bedrock Groundwater Depletions	1,050	2,090	3,130	3,950	5,250

Notes:
(1) Source: OCWP Panhandle Watershed Planning Region Report.

The significance of the data presented in Table 2.8 is that the most significant issues are expected to occur with the use of bedrock groundwater exceeding recharge, although surface water flows and alluvial groundwater recharge are projected to also fall short of demand.

The OCWP examined a range of potential water supply strategies to mitigate projected shortages, unique to each OCWP basin. It found that moderately expanded permanent conservation activities in the Panhandle's Public Supply (M&I) and Crop Irrigation demand sectors could reduce gaps and storage depletions. It also noted that water users in the Panhandle should focus on permanent conservation activities, instead of temporary drought management activities, as gaps and storage depletions have a high probability of occurring each year. The OCWP concluded that out-of-basin supplies could be developed to supplement the basin's water supplies and reduce or eliminate gaps and storage depletions. However, out-of-basin supplies may not be cost-effective for all users based on the availability of groundwater resources and distance to reliable surface water supplies. The OCWP found that reservoir storage in the Panhandle is not recommended without a detailed feasibility analysis, due to limited surface water supplies and lack of future permit availability. Increased reliance on surface water supplies, without reservoir storage, was considered but found not to be a reliable solution. Increased reliance on groundwater supplies could mitigate surface water gaps, but would increase the amount of groundwater storage depletions. The increases in storage depletions would be minimal relative to the volume of water in storage for the region's portion of the Ogallala aquifer. However, localized depletions may adversely affect groundwater users.

These and other water management strategies are explored in Chapter 3 of this PRWP.

2.3.2 Water Level Projections

As discussed in Section 2.1.1, a study performed by the USGS and the Oklahoma Water Resources Board (OWRB) in the late 1990s used groundwater modeling to project declining groundwater levels through 2020. As of 2012, these projections have been generally validated by ongoing well level measurements and water users' experiences.

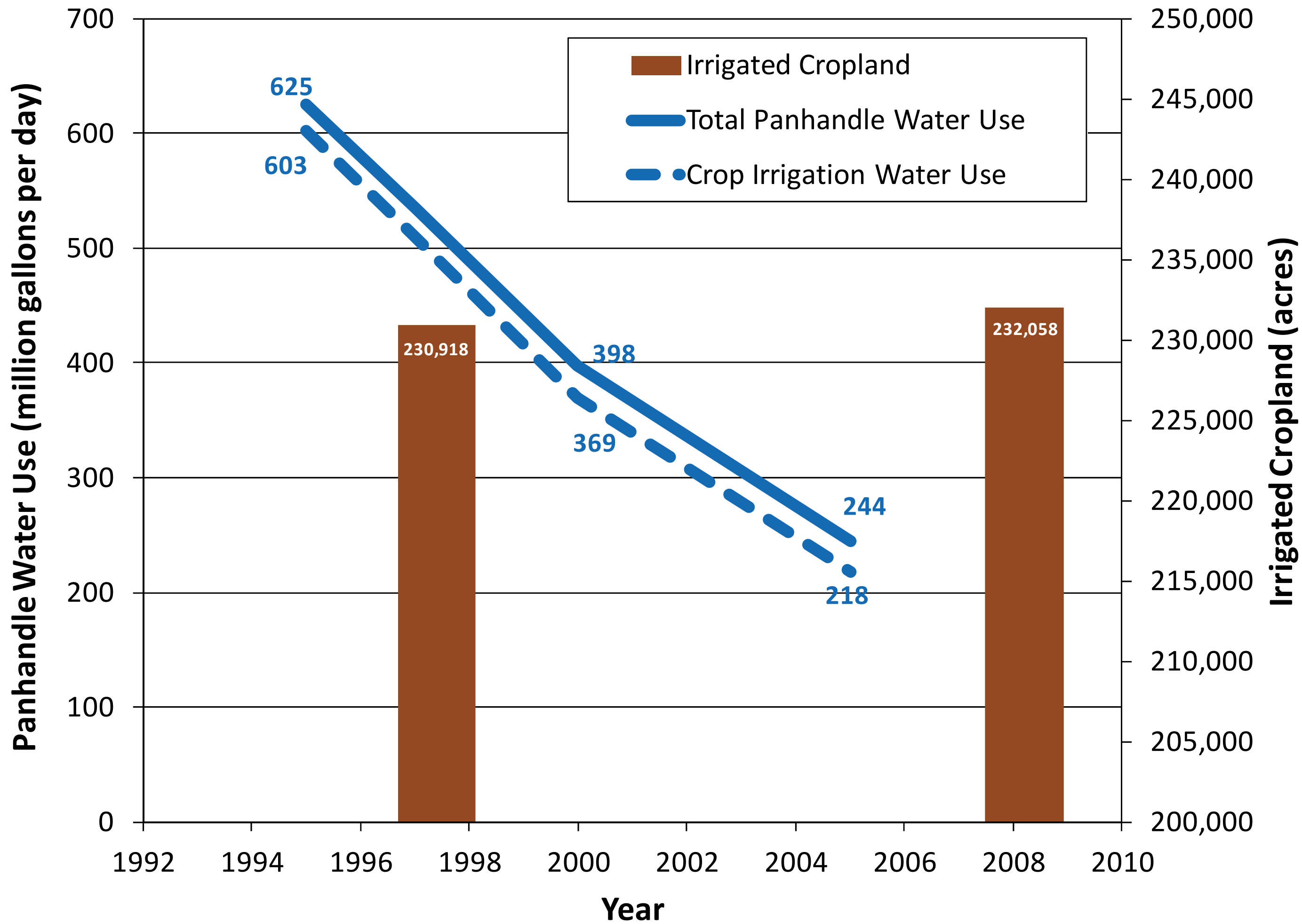
However, the agriculture community and other water users have implemented dramatic conservation measures and water reuse. Water use data and water level data suggest that we no longer are seeing as steep of declines as a result. Water use data that peaked in the 1970s has consistently dropped since that time. Data published by the USGS indicate significant reductions in water use in the Panhandle counties from 1995 to 2000, and again from 2000 to 2005, as shown in Figure 2.10. While a variety of factors could be driving this reduction in use (e.g., irrigation technologies, supply availability, crops planted, energy costs, other market drivers), the reduction in use over the ten-year period from 1995 to 2005 can certainly be expected to result in lower rates of decline in the aquifer. During about the same time period, data from the Census of Agriculture indicate that irrigated cropland in the three Panhandle counties stayed about constant (increasing by less than 1 percent from 1997 to 2007), also shown in Figure 2.10.

While water use dropped and irrigated cropland held constant, the market value of agricultural products sold in the Panhandle increased by more than 10 percent, as shown in Figure 2.11.

Together, these data indicate that efficient water management strategies can and do support a vibrant Panhandle economy. Investments made in irrigation and crop technologies and efficiencies have made a difference. Farmers have already taken steps to preserve and extend the life of the aquifer, investing in conservation, and these programs must continue. Increased regulatory programs would not be expected to meet the goals of the Panhandle Regional Water Planning Group, but more financial and technical assistance can be key to extending the life of the aquifer.

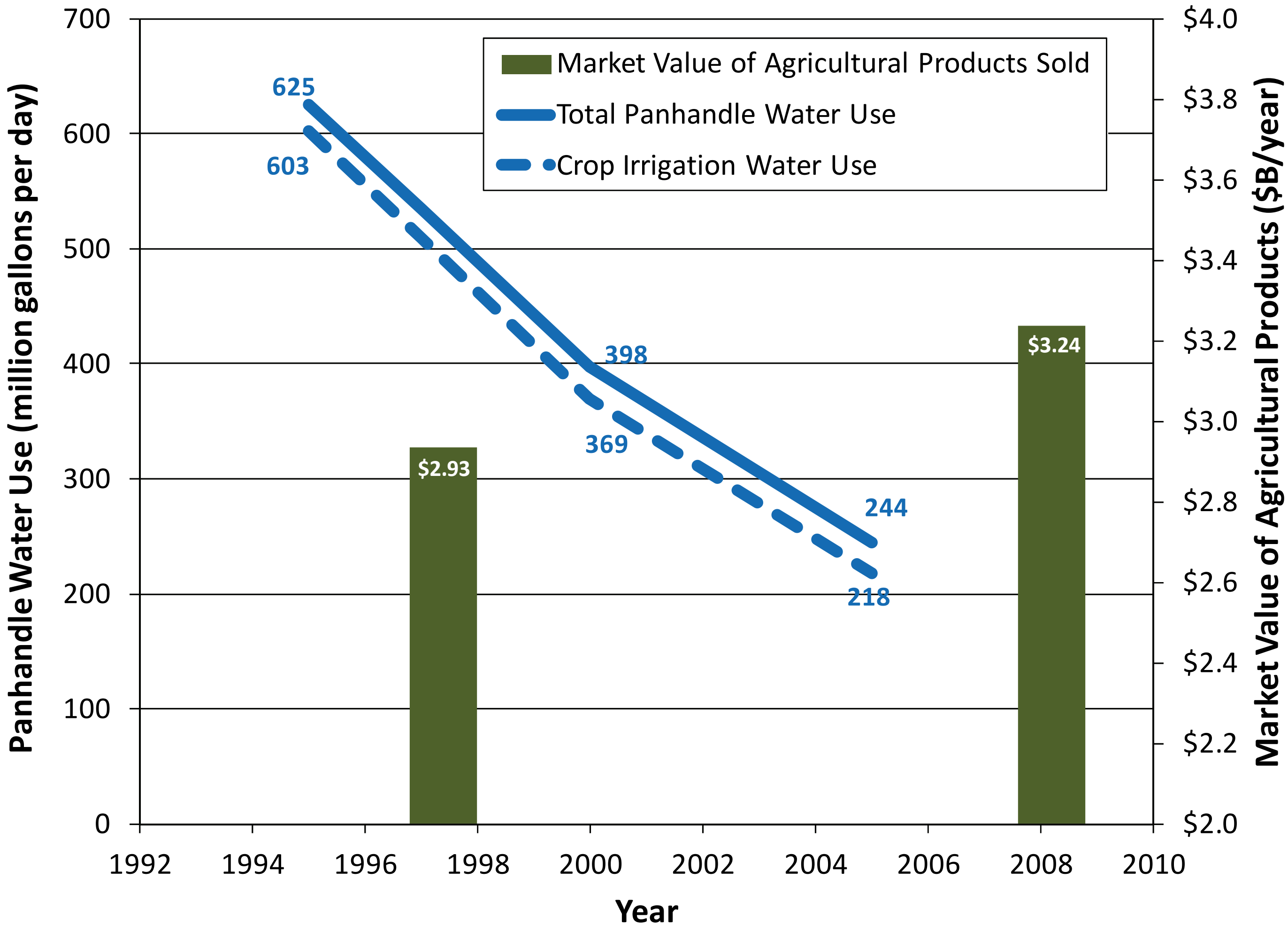
2.4 MUNICIPAL WATER REUSE AND CONSERVATION

Demand management is one of several potential water management strategies that is already employed in the Panhandle. Enhanced water conservation programs and increased water reuse in the Panhandle are explored below, and compared to other strategies in Chapter 3 of this report. These approaches can help reduce demands on fresh water supplies, and can also help reduce the cost of water supply, treatment, and conveyance infrastructure.



WATER USE AND IRRIGATED CROPLAND IN THE PANHANDLE
(USGS 1995, 2000, 2009; CENSUS OF AGRICULTURE 1997-2007)

FIGURE 2.10



WATER USE AND MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD IN THE PANHANDLE (USGS 1995, 2000, 2009; CENSUS OF AGRICULTURE 1997-2007)

FIGURE 2.11

OKLAHOMA PANHANDLE AGRICULTURE AND IRRIGATION
PANHANDLE REGIONAL ECONOMIC DEVELOPMENT COALITION, INC.
PANHANDLE REGIONAL WATER PLAN

Because such a large portion of the water use in the Panhandle region is used for crop irrigation, municipal conservation and water reuse are often overlooked as ways to address supply concerns for the future. However, because of the localized effects of groundwater pumping, reductions in demand can help alleviate some of the economic and operational issues associated with municipal water supply in the Panhandle.

Municipal conservation programs are geared toward changing the amount of water used by customers on a public water supply system, usually geared toward changing water use fixtures and behaviors in residences and businesses. Reuse of treated wastewater effluent from municipal wastewater treatment facilities can serve a variety of purposes, ranging from non-potable uses such as irrigation of turfgrass or crops, to augmentation of potable water supply sources such as lakes or recharging groundwater. Where reuse is used to offset irrigation demands, communities can not only reduce the overall use of potable water, but can reduce the size and cost of potable water treatment and distribution facilities due to the reduction in seasonal peak-demand irrigation uses of potable water.

2.4.1 Municipal Water Reuse

The City of Guymon is an example of a community that already utilizes treated effluent to offset some demands in and around the city. The city provides treated effluent to 10 center pivots near its wastewater treatment facility that are currently growing an alfalfa crop. As the Oklahoma Department of Environmental Quality (ODEQ) begins to implement its new reuse standards for non-potable applications (first adopted in January 2012), Guymon hopes to expand its reuse program to include irrigation of the Sunset Hills golf course. Legislation passed by the State Legislature in the 2012 session included a requirement that ODEQ develop indirect potable reuse regulations – which would govern the intentional augmentation of potable water supply sources using treated effluent – by mid-2013. Guymon is also interested in augmenting Sunset Lake for this use.

Other similar opportunities exist throughout the Panhandle. However, because crop irrigation demands of the region are much larger than municipal (public water supply) demands, it will not be possible to reduce a significant percentage of crop irrigation demands with reuse of municipal effluent.

2.4.2 Municipal Water Conservation

In the 2012 OCWP, potential conservation methods were evaluated for the M&I water demand sector for each county in the state. The OCWP evaluated two different hypothetical scenarios for increased conservation, as follows:

- Scenario I – moderately increased conservation, including a “package” of conservation measures and programs geared toward initial implementation or building on existing programs.

- Scenario II – significantly increased conservation, including more complete community-wide adoption of certain conservation measures and programs.

Both Scenarios I and II include “passive” conservation, which refers to the replacement over time of high-flow toilets and other household fixtures with lower-flow fixtures, as mandated by federal law as part of 1992 federal legislation. The specific components of Scenarios I and II conservation packages is listed below. For each conservation scenario, the potential for savings was estimated relative to existing conservation practices and programs in the communities in each county. For example, if conservation-oriented billing rate structures were already in place in a county, that county would not get credit for additional demand reduction associated with conservation-oriented billing rate structures under Scenarios I or II.

Scenario I included the following:

- Passive conservation (fully implemented by 2030).
- Partial implementation of customer metering program by at least 90 percent of providers in each county.
- System losses reduction to 12 percent where applicable.
- Implementation of conservation pricing for:
  - 60 percent of customers in metropolitan areas.
  - 40 percent of customers in urban populations > 2,500.
  - 20 percent of customers in rural counties.
- Educational programs by all providers (water bill inserts and websites with conservation tips).

Scenario II included the following:

- Passive conservation.
- Implementation of metering by all providers statewide.
- System losses reduction to 10 percent where applicable.
- Implementation of conservation pricing for:
  - 100 percent of customers in metropolitan areas.
  - 80 percent of customers in urban populations > 2,500.
  - 60 percent of customers in rural counties.
- Educational programs by all providers (to reduce demands by 5 percent), including water bill inserts, websites with conservation tips, school educational programs, and media campaigns.

Figure 2.12 shows the projected results of these conservation scenarios for the Panhandle counties in 2060, in terms of baseline M&I (public water supply) demands and M&I demands under Scenarios I and II. While these two specific scenarios or “packages” of conservation measures demonstrate the potential range of savings, the actual conservation measures to be implemented in any community should reflect the community’s values and other aspects unique to each provider’s service area and customer base.

2.5 ALTERNATIVE CROP IRRIGATION SCENARIOS

Crop irrigation is by far the largest demand sector in the Panhandle. Differences between the withdrawals from the Ogallala and its rate of recharge are largely driven by agricultural pumping. Agriculture has a significant interest in the ongoing ability to use the region’s water supplies to its economic and community benefit, consistent with the overall goals of this PRWP and the PRWP planning group.

Demand management is one strategy that is potentially available to irrigators in the Panhandle. This could occur through changing the types of crops planted, as examined in some hypothetical analyses in the OCWP, and/or through continuing to change over irrigation equipment that more efficiently applies water and therefore comes closer to applying the actual amount of water needed by the crop. Both of these approaches have economic implications – including costs of equipment and revenue potential for harvested crops – that are explored in the sections that follow.

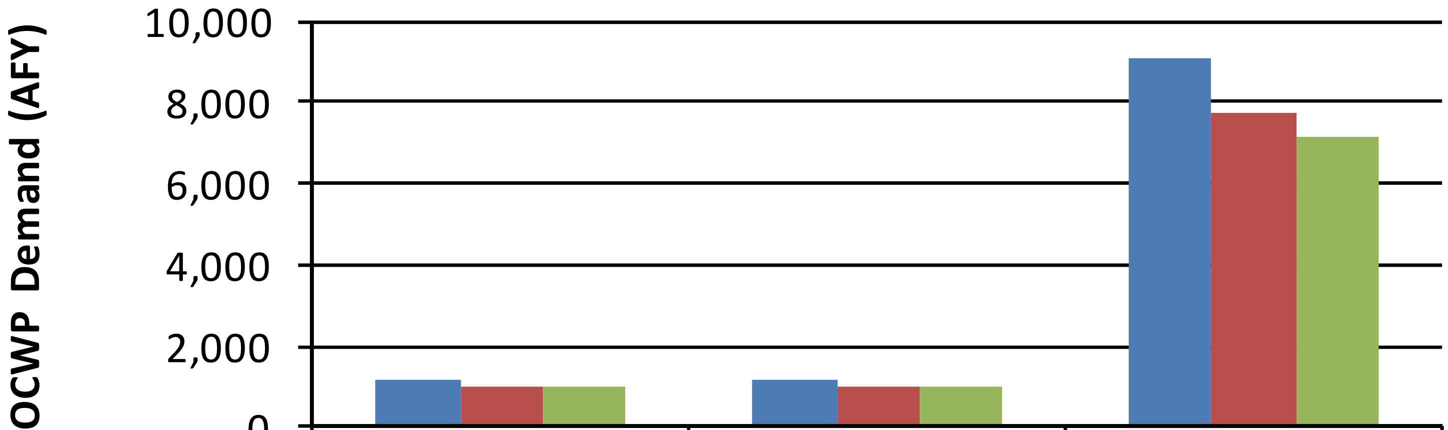
2.5.1 Baseline Information

The National Agricultural Statistics Service collects data on crop harvests by county. The aggregate irrigated harvest statistics for Cimarron, Texas, and Beaver counties are shown in Figure 2.13.

The current Panhandle crop mix, displayed in Figure 2.13, shows a crop breakdown predominantly favoring wheat and corn. Corn for grain has a reported normal CIR at Goodwell, OK (the most representative city having CIR data for the Panhandle) of 1.5 AF/ac and a dry year CIR of 1.7 AF/ac. Compared to the average CIRs of wheat and sorghum, 0.5 and 1.1 respectively, corn is a more water intensive crop in terms of water used per acre of crop. Depending on local conditions and precipitation patterns, annual water use can exceed 2 AF/ac for corn and 1.5 AF/ac for wheat in the Panhandle. Corn produces more bushels per acre, making it one of the most economically valuable crops in today’s market.

As shown in Figure 2.13, the crop with the largest irrigated area of harvested acreage in the Panhandle in 2007 was wheat for grain at 39 percent. Corn for grain also comprises a substantial share, at 36 percent of agricultural acreage. Sorghum, Hay Grass, Greenchop, and Other comprised the remaining 25 percent of the harvested area for the three counties.

Irrigation methods were also reported on in the 2007 Census of Agriculture. The irrigation methods used on average in the Panhandle are shown below in Table 2.9.

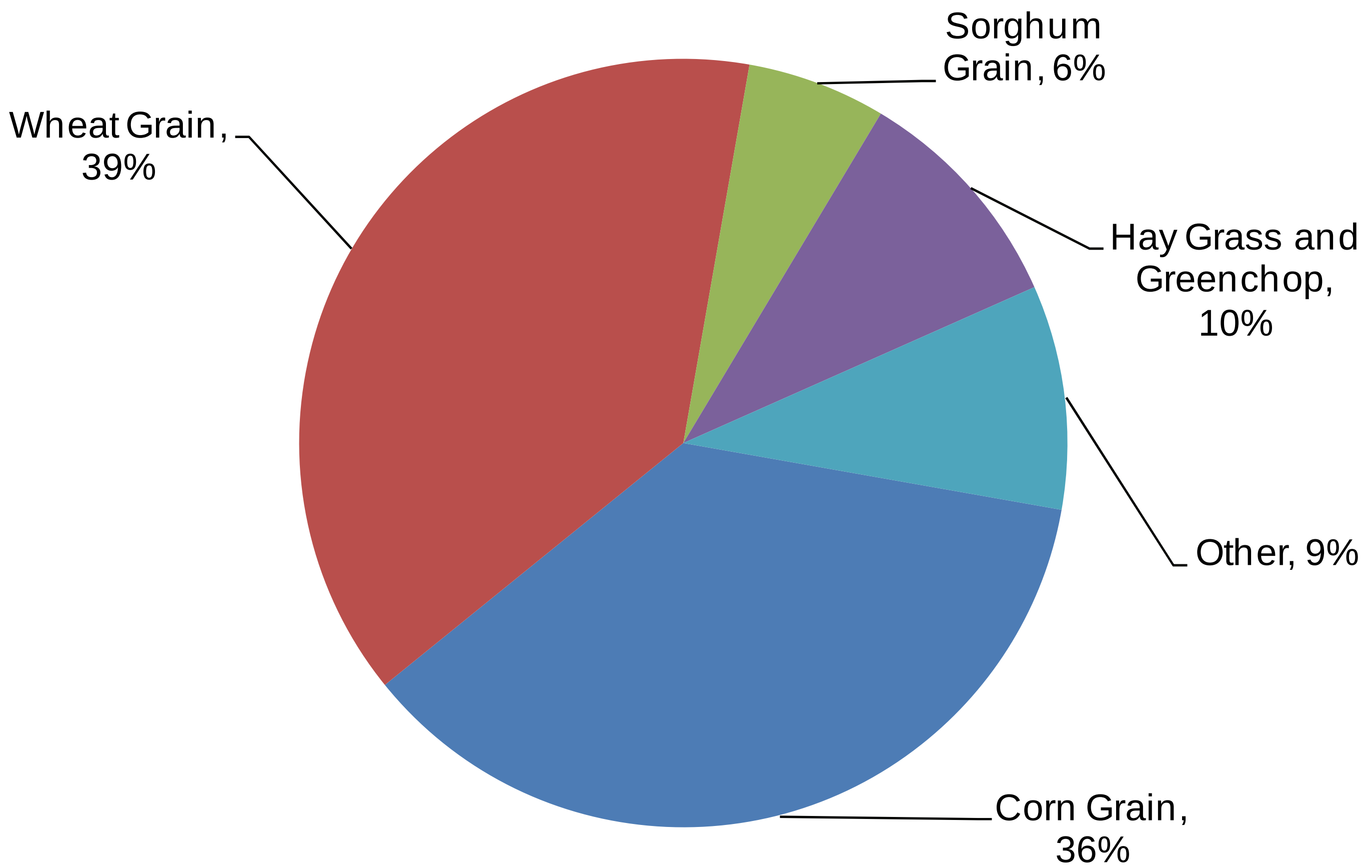


	Beaver	Cimarron	Texas
Baseline Demand	1,169	1,136	9,056
With Scenario I Conservation	1,048	1,029	7,776
With Scenario II Conservation	994	966	7,169

PUBLIC WATER SUPPLY DEMANDS UNDER TWO CONSERVATION SCENARIOS (OCWP 2012)

FIGURE 2.12

OKLAHOMA PANHANDLE AGRICULTURE AND IRRIGATION
PANHANDLE REGIONAL ECONOMIC DEVELOPMENT COALITION, INC.
PANHANDLE REGIONAL WATER PLAN



IRRIGATED ACREAGE OF PANHANDLE COUNTIES CROP HARVEST IN 2007

FIGURE 2.13

OKLAHOMA PANHANDLE AGRICULTURE AND IRRIGATION
PANHANDLE REGIONAL ECONOMIC DEVELOPMENT COALITION, INC.
PANHANDLE REGIONAL WATER PLAN

Table 2.9 Irrigation Technology Utilization and Efficiency		
Irrigation Type	**Panhandle Utilization**	**Field Application Efficiency**
Surface Irrigation	5%	64%
Sprinkler Irrigation	95%	85%
Micro-irrigation	0%	89%
Notes: (1) Source: OCWP 2012 Agriculture and Demand Model.		

As shown in Table 2.9, irrigation by sprinkler is the most prevalent type of irrigation in the Panhandle. The two most common methods of irrigation within the Panhandle are surface irrigation and sprinkler irrigation. The weighted average field application efficiency for the Panhandle is about 84 percent using existing irrigation equipment. Conversion of equipment from surface irrigation to micro-irrigation could reduce the amount of water that needs to be applied to meet the crops' CIR. Similarly, though to a lesser degree, conversion from sprinklers to micro-irrigation could also reduce demands for a given crop and acreage.

Surface irrigation, also called flood irrigation, takes advantage of gravity to distribute water across a crop, typically through a network of canals and furrows. This approach to irrigation is relatively inefficient with only 64 percent of water applied effectively being utilized by the crop. Sprinkler irrigation is by far the most common method utilized in the Panhandle. Sprinklers are pump powered mechanical devices that distribute water in a fixed pattern on and around the crop. Micro-irrigation, also referred to as drip irrigation, is a form of localized irrigation where irrigation water is distributed at low pressures with a small discharge next to each individual plant. This approach allows for relatively high water use efficiency, with 89 percent of water being utilized by the plant.

The increase in efficiency with micro-irrigation comes at an additional capital cost. OPAI members suggested that current costs are about $1,500 to equip an acre of land with drip systems, as opposed to approximately $800 to equip an acre with sprinkler irrigation. With the vast majority of farms already having functional irrigation systems, the cost to replace the existing sprinkler or surface irrigation equipment with micro-irrigation systems must be carefully evaluated relative to maintaining the existing system.

Pumping costs for irrigating a given acreage would be lower when using more efficient equipment, in that the amount of water applied to an acre would be reduced and the pumping costs would decrease proportionally. OPAI members estimate that pumping a typical Panhandle well costs about the same in dollars per inch of water applied as the current cost of an mcf of natural gas. At current prices, that translates to an operational cost for power to pump water equal to about $60 per AF pumped. Some irrigators in other parts of the state have also reported labor savings associated with switching from surface irrigation to other technologies. Those savings were not quantified as part of the PRWP.

Crop irrigation water use has already benefited from research and development into drought-tolerant seed species. Ongoing efforts at Oklahoma Panhandle State University, Oklahoma State University, and other leading research institutions are continually seeking ways to maintain or increase crop yields while reducing water needs. These efforts are reflected in today's CIR values. Similarly, research and development into new, cost-effective irrigation technology alternatives is helping to bring the gross irrigation requirement down closer and closer to the net CIR requirement, by reducing water lost to runoff, evaporation, or seepage past the root zone.

2.5.2 Baseline Cropping and Water Usage Estimates

Based on 2007 crop mix data, there are approximately 230,051 acres of irrigated agriculture in the Oklahoma Panhandle. The total acreage breakdown of these crops is shown in Table 2.10.

Table 2.10 Panhandle Crop Mix and Water Demand in 2007

Crop Type	Total Irrigated Acreage (acres)	Irrigated Acreage (%)	Crop Irrigation Require.(1) (AF/acre)	Net CIR Require. (AF)	Gross Irrigation Require.(2) (AF)
Corn Grain	83,699	36 %	1.5(4)	125,549	149,944
Wheat Grain	88,795	39 %	0.5(4)	44,398	53,024
Sorghum Grain	13,432	6 %	1.1	14,775	17,646
Hay, Grass and Greenchop	22,424	10 %	1.7	38,121	45,528
Other	21,701	9 %	1.2	26,041	31,101
Total	**230,051**	-	-	**248,883**	**297,244**

Notes:

(1) Normal year CIRs were used to calculate net irrigation requirements. CIRs are discussed in more detail in Section 2.5.4.

(2) Accounts for application efficiency, based on 5 percent surface irrigation and 95 percent sprinkler irrigation.

(3) Sources of data include 2007 Census of Agricultural and the OCWP 2012 Agricultural Demand Model.

(4) Depending on local conditions and precipitation patterns, annual water use can exceed 2 AF/ac for corn and 1.5 AF/ac for wheat in the Panhandle.

As shown in Table 2.10, wheat and corn compose the majority of irrigated crop acreage in the panhandle. Corn also has a relatively high CIR compared to wheat or sorghum. The relatively high CIR of corn means that, despite having similar total acreage to wheat, corn comprises approximately half of the Panhandle's crop irrigation demand. The last two columns of the table demonstrate the difference between the water required by the different crop types under 2007 cropping conditions, and the amount of water needed to meet those requirements based on the field application efficiency of current irrigation methods. These data form the baseline irrigation requirement.

2.5.3 Alternative Irrigation System Analysis

To evaluate the maximum theoretical water use savings associated with a conversion to more efficient irrigation systems, an analysis was conducted in which 100 percent of all crop irrigation in the Panhandle would be conducted using micro-irrigation systems. In reality, conversion to micro-irrigation would occur over a long period of time, and may never reach this extreme. Also, this conversion would come at a substantial capital cost, as further described below. Table 2.11summarizes the potential water savings of this conversion.

Table 2.11 Potential Water Savings with Conversion to 100% Micro-Irrigation

Crop Type	Net CIR Requirement(1) (AF)	Gross Baseline Irrigation Requirement(2) (AF)	Gross Irrigation Requirement with 100% Micro-irrigation(3) (AF)	Potential Water Savings (AF)
Corn Grain	125,549	149,944	141,066	8,878
Wheat Grain	44,398	53,024	49,885	3,139
Sorghum Grain	14,775	17,646	16,601	1,045
Hay, Grass and Greenchop	38,121	45,528	42,833	2,695
Other	26,041	31,101	29,260	1,841
Total	**248,883**	**297,244**	**279,645**	**17,598**

Notes:

(1) From Table 2.10.

(2) Based on average breakdown of 5 percent surface irrigation and 95 percent sprinkler irrigation.

(3) Assumes 100 percent micro-irrigation, therefore an irrigation efficiency of 89 percent for all irrigated acres.

As shown in Table 2.11, the current irrigation requirements for the Panhandle are approximately 300,000 AF for each harvest. Converting all irrigation to micro-irrigation could theoretically reduce demands by approximately 17,500 AF of water per harvest through increased irrigation efficiency, equal to about a 6 percent reduction in crop irrigation water use relative to current irrigation practices.

The increases in field application efficiency and pumping cost savings granted by switching to micro-irrigation need to be weighed against the cost of implementation. Micro-irrigation equipment has a capital cost of about $1,500 per acre, while sprinkler irrigation systems carry a capital cost of approximately $800 per acre (OPAI, personal communication, April 2012).

The average lifespan of micro-irrigation is assumed to be 10 years (estimated, based on limited operational history), while the lifespan of sprinkler irrigation is about 20 years. Amortized over its 10-year lifespan at a discount rate of 2 percent, micro-irrigation carries an annualized cost of about $170 per acre of irrigated land per year. Amortized over its 20-year lifespan at a discount rate of 2 percent, sprinkler irrigation equipment carries an annualized cost of about $50 per acre of irrigated land per year.

The capital cost to complete a one-time micro-irrigation retrofit could exceed $345 million. If operated for a period of 10 crop harvests, it would reduce demand by a cumulative total over those 10 harvests of approximately 175,000 AF of water, resulting in a per-AF capital cost of more than $1,500 per AF of water conserved.

Input from OPAI members suggests that water savings that might be realized through conservation methods could potentially be used to increase the number of irrigated acres. If that were the case, the capital costs of micro-irrigation equipment could be at least partially offset by the potential to grow and sell more irrigated crops with a given amount of water.

If those newly-irrigated acres were planted with 100 percent corn for grain and used 100 percent micro-irrigation, you could grow an additional 10,400 acres of corn in the Panhandle after investing about $16 million to equip that land with micro-irrigation equipment. That in turn would bring in an additional $11.5 million per year in crop revenues (based on current estimates of yield and per-bushel revenue for corn in the Panhandle). The overall $361 million investment in micro-irrigation (assuming no land costs and neglecting any changes in annual operation and maintenance costs) would therefore take more than the 10-year assumed life expectancy of the micro-irrigation equipment to repay itself.

Annual costs might be increased through increased maintenance, but decreased through reduced power costs for well pumping to irrigate an acre of land. Current pumping costs in the Panhandle region are approximately $60 per AF (OPAI, personal communication, April 2012). For an acre of corn with a CIR of 1.5 AF/ac, micro-irrigation would reduce power costs for pumping by approximately $40 per acre irrigated over surface irrigation and $5 per acre irrigated over sprinkler irrigation. The number of average irrigated acres of an Oklahoma farm in 2007 was about 1,500 acres. Converting from sprinkler to micro-irrigation on an average sized, fully irrigated corn farm could result in pumping cost savings of $7,000 per harvest.

In summary, due to the relatively high capital cost of micro-irrigation, many years of lowered pumping costs would be needed to pay back the initial investment. If the conserved water was not used to increase the number of irrigated acres, other economic benefits not considered might include a slower decline in groundwater levels. This would in turn reduce pumping costs and the need to re-drill wells.

2.5.4 Alternate Cropping Pattern Analysis

Another potential approach to reduce water use or increase the number of irrigated acres in the Panhandle is alternative cropping patterns. The current crop mix described in Figure 2.13 is associated with a total water use of approximately 300,000 AFY for the Panhandle. The breakdown of current (2007) crop mixes for each Panhandle county is shown in Table 2.12. Water supply availability can also affect crop selection. For example, in areas with marginal supply availability, it may be possible to produce a cotton crop in areas where corn could not be supported.

Table 2.12 Crop Mix by County in 2007

Crop Type	Total Crop Acreage (ac)			
	Cimarron County	**Texas County**	**Beaver County**	**Panhandle Total**
Corn Grain	13,018	66,291	4,390	83,699
Wheat Grain	16,550	61,009	11,236	88,795
Sorghum Grain	1,038	9,847	2,547	13,432
Hay, Grass and Greenchop	8,475	8,135	5,814	22,424
Other	6,432	10,744	4,525	21,701
Total	**45,513**	**156,026**	**28,512**	**230,051**

Notes:
(1) Data from OCWP 2012 Demand Model.

Table 2.12 shows that corn and wheat are the predominant crop types found in the Panhandle and that Texas County has the majority of the irrigated acreage in the region. In fact, more than half of the irrigated acreage in the Panhandle is devoted to corn and wheat in Texas County. Local experience suggests that corn and wheat often require more water in the Panhandle than cited in the OCWP demand projections and other literature sources. Depending on local conditions and precipitation patterns, annual water use can exceed 2 AF/ac for corn and 1.5 AF/ac for wheat in the Panhandle.

The concept of shifting crop mixes away from corn to less water intensive crops (such as wheat or sorghum) has been discussed in many venues, including in the 2012 OCWP. However, those analyses have typically not assessed the economic implications of these types of changes. In reality, market drivers historically have governed the selection of crops in the Panhandle and throughout the nation's agricultural areas. For purposes of this PRWP, hypothetical alternate crop mixes were examined in light of revenue implications to provide a better understanding of the economic realities of crop mix selection.

Three different hypothetical demand scenarios were analyzed to evaluate the potential effects of this change:

1. The current (2007) crop mix,
2. Scenario I, where half the corn in each county is replaced with wheat and sorghum, and
3. Scenario II, where all the corn in each county is replaced with wheat and sorghum.

Hay, grass, greenchop, and other crops are unchanged in each scenario. The acreages for these scenarios are presented in Table 2.13. In this initial analysis, it is assumed that the conserved water would not be used to irrigate additional acres – that is, the number of irrigated acres would remain constant. Subsequently, an analysis was conducted to assess the potential for increasing the number of irrigated acres while holding total Panhandle water use constant.

Table 2.13 Hypothetical Alternative Crop Mix Scenarios

Crop Type	Irrigated Land (acres)		
	Current (2007)	**Scenario I**	**Scenario II**
Corn for Grain	83,699	41,850	-
Wheat for Grain	88,795	109,720	130,645
Sorghum for Grain	13,432	34,357	55,282
Hay, Grass and Greenchop	22,424	22,424	22,424
Other	21,701	21,701	21,701
Total	**230,051**	**230,051**	**230,051**

The water demand for these three different crop scenarios with a constant number of total irrigated acres is summarized in Table 2.14; all scenarios assume the current 5 percent and 95 percent breakdown between surface and sprinkler irrigation.

Table 2.14 Crop Irrigation Demands for Hypothetical Alternative Crop Mix Scenarios			
	Gross Water Demand (AF)		
Crop Type	**Baseline**	**Scenario I**	**Scenario II**
Corn for Grain	149,944	74,973	-
Wheat for Grain	53,024	65,520	78,015
Sorghum for Grain	17,646	45,136	72,626
Hay, Grass and Greenchop	45,528	45,528	45,528
Other	31,101	31,101	31,101
Total	**297,244**	**262,259**	**227,271**

As shown in Table 2.14, replacing corn production with other crops on the same irrigated acreage could reduce the irrigation demands for the region by 35,000 to 70,000 AF, equal to about 12 to 24 percent of the current baseline crop irrigation demand of approximately 300,000 AF.

Changing crop mixes without increasing the number of irrigated acres would have an economic impact, since different crops have different yields and prices. Recent market prices were used to provide a relative measure of revenue difference. For calculating revenue, average yield per acre was taken from the National Agricultural Statistics Service and is assumed to be 182 bushels per acre of corn, 41 bushels per acre of wheat, and 2.8 tons per acre of hay, grass and greenchop (USDA, 2012). Local yields of sorghum are known to exceed USDA estimates, with a value of 102 bushels per acre assumed for these analyses based on OPAI experience. Market prices were taken from the USDA for Oklahoma in April 2012, and are assumed to be $6.23 per bushel of corn, $6.37 per bushel of wheat, $10.14 per hundredweight of sorghum (about $5.63/bushel), and $140 per ton of hay, grass and greenchop (NASS, 2012). The category of “Other” was assigned a constant revenue of $250 per acre.

As shown in Table 2.15, total revenue generated by crop yields will decrease substantially with the replacement of corn in Scenarios I and II. In Scenario I, where half of the corn in each county is replaced with wheat and sorghum, the total revenue decreased by 21 percent. If all corn in the Panhandle were to be replaced by wheat and sorghum, the total crop revenue would decrease by nearly $60 million per harvest – a reduction of 43 percent of current revenue.

Table 2.15 Revenue Implications for Hypothetical Alternative Crop Mix Scenarios			
	Crop Revenue ($/harvest)		
Crop Type	**Current**	**Scenario I**	**Scenario II**
Corn for Grain	$94,903,000	$47,451,000	-
Wheat for Grain	$23,191,000	$28,656,000	$34,120,000
Sorghum for Grain	$7.718,000	$19.741,000	$31,765,000
Hay, Grass and Greenchop	$8,790,000	$8,790,000	$8,790,000
Other	$5,425,000	$5,425,000	$5,425,000
Total	**$140,027,000**	**$110.063,000**	**$80,100,000**

If, under Scenario II, the 70,000 AF of conserved water were used to irrigate new acres of irrigated wheat, water use would remain the same, but the water would be used to irrigate more land – thus increasing revenues over the "constant acreage" situation described above. At a normal year CIR of 0.5 AF/ac for wheat in Texas County and if all the newly irrigated land were equipped with micro-irrigation systems, that conserved water could be used to irrigate an additional 124,600 acres of wheat. Equipping the new land with micro-irrigation equipment would cost $187 million. Revenues per harvest at the previously mentioned yields and prices for wheat on the newly-irrigated acres would be $32.5 million. This falls short of covering the $60 million reduction in per-harvest revenue from the baseline scenario, and thus could also not pay off the investment in new irrigation equipment.

2.6 SUMMARY

Major improvements in agricultural and municipal water use practices have reduced Panhandle water demands from their peaks in the 1970s, resulting in dramatic water savings. Additional investments in crop research and irrigation technologies are ongoing, as are efforts to conserve and reuse water in the Panhandle's towns and cities. Significant progress has already been made in efficient use of the available water supplies. Estimates developed as part of the PRWP suggest, however, that careful consideration must be given to the economic implications and return on investment of wholesale changeovers to micro-irrigation equipment or to low water-use crops. Continued investments in research programs and conservation and reuse equipment and infrastructure are critical to maintaining the economic vitality of the Panhandle into the future.

WATER MANAGEMENT STRATEGIES

3.1 OCWP POLICY RECOMMENDATIONS

As part of the 2012 Oklahoma Comprehensive Water Plan (OCWP), the Oklahoma Water Resources Board (OWRB) conducted a 4-year public participation program. This included a series of local input meetings, regional input meetings, planning workshops, and a Town Hall meeting dedicated to statewide water issues. This process brought forth and explored water management issues identified by Oklahomans across the state.

In tandem with the statewide input process, the OWRB convened focused workgroups for specific water policy and technical issues. Through its own operations, the OWRB also identified specific issues and policy recommendations for enhanced water use administration, water data for decision-making, infrastructure financing, water-related research, and legal issues.

Together, these sources of input and information formed the basis for OWRB's development of specific policy recommendations in the OCWP Executive Report. Because these recommendations were developed with input from across the state – and given the diversity of water environments evident from one corner of the state to another – not all of the OCWP policy recommendations are universally applicable.

Each of the OCWP policy recommendations for water management is listed in this section, followed by actions for Panhandle water stakeholders as they relate to these OCWP recommendations.

3.1.1 Priority Recommendations

3.1.1.1 <u>Water Project and Infrastructure Funding</u>

OCWP Recommendation: To address Oklahoma's considerable drinking water and wastewater infrastructure need and the inability of current programs to meet that need, the OWRB should coordinate with a team of infrastructure financing professionals to investigate development of a more robust state funding program to meet the state's projected water and wastewater infrastructure need between now and 2060. Any potential program(s) should include a specific mechanism to address the significant financing requirement of small communities in the state, as well as encourage regionalization of water/wastewater systems, where appropriate.

Applicability to the Panhandle: Communities and rural water districts in the Panhandle are faced with significant capital and operating costs to maintain and operate their public water supply and wastewater systems. Many of these costs are driven by federal and state regulations that are beyond the control of the Panhandle communities and water utilities.

Panhandle Action:

- Support legislation or other initiatives for state and federal funding and financing programs that would provide economic relief to the citizens of the Panhandle.
- Consider regionalization of systems, where it is economically, technically, and politically feasible.

3.1.1.2 Regional Planning Groups

OCWP Recommendation: The OWRB should work with the State Legislature to develop and authorize the creation of at least 13 Regional Planning Groups to assist in planning and implementing OCWP initiatives at the regional level. These regional groups should be non-regulatory and consist of local stakeholders, as well as appropriate agency representatives, charged with developing regional water plans in a manner consistent with the OCWP and its implementation priorities. Such plans would include the identification of specific projects, studies, programs, research, and other evaluations designed to address the unique needs and issues identified by Regional Planning Group participants. The State Legislature should establish regular appropriations to the OWRB to coordinate the activities of these groups.

Applicability to the Panhandle: The value of local and regional water planning to the economic vitality of the Panhandle is evidenced by the initiative undertaken by OPAI and PREDCI to develop this Panhandle Regional Water Plan. This demonstrates that regional planning, driven by local and regional needs and priorities, can be successfully initiated without legislative mandates. Statewide planning should continue to serve in a coordination role between local and regional plans. While the OCWP utilized a watershed-based approach to defining planning regions, there may be instances like the Panhandle where more traditional county-level planning and coordination better serves the needs of the local water users.

Panhandle Action:

- Continue to monitor the development of legislation for regional planning groups, and provide advocacy for locally-initiated and locally-driven regional water planning initiatives without formal legislative mandates.
- PREDCI and OPAI should formalize a long term relationship through formation of a Panhandle Regional Water Planning Workgroup, whose goals are to:
  - Implement recommendations of the Panhandle Regional Water Plan.
  - Work with research institutions to provide more drought tolerant crops.
  - Work with state water management agencies to reduce administrative burden on agricultural producers, cities, and industries and implement strategies that provide voluntary cost share incentives to conserve water and extend the life of the Ogallala Aquifer.

- Work with federal agencies to leverage financial and technical expertise to implement water management strategies.
- Work diligently to support programs that protect private water rights and oppose any and all efforts that dilute the rights of property owners.

3.1.1.3 Excess and Surplus Water

OCWP Recommendation: Pursuant to its statutory mandate found at 82 O.S. 1086.2(1), the OWRB adopts the following definition and procedure for determining excess and surplus water for inclusion in the OCWP update:

"Excess and surplus water" means the projected surface water available for new permits in 2060, less an in-basin reserve amount, for each of the 80 basins as set forth in the 2012 OCWP Watershed Planning Region Reports whose surface water is under OWRB jurisdiction (excepting the Grand Region); provided that nothing in this definition is intended to affect ownership rights to groundwater and that groundwater is not considered excess and surplus water.

The OCWP goes on to propose a method for estimating excess and surplus water, as required by state statute.

Applicability to the Panhandle: In the OCWP's estimation of excess and surplus water for each of the 82 OCWP basins, every single basin in the Panhandle was identified as having zero excess and surplus water. This is consistent with water users' experience and institutional knowledge of Panhandle water supplies.

Panhandle Action:

- Monitor any future changes to the method for estimating excess and surplus water.

3.1.1.4 Instream/Environmental Flows

OCWP Recommendation: The process developed by the OCWP Instream Flow Workgroup should be implemented and followed to ascertain the suitability and structure of an instream flow program for Oklahoma, with such process commencing in 2012 and concluding by 2015, as outlined by the Workgroup.

Applicability to the Panhandle: Because of the extremely limited and intermittent nature of surface water flows in the Panhandle, instream/environmental flow issues are largely inapplicable in the Panhandle. One approach contemplated in the OCWP instream flow workgroup process was to focus instream/environmental flow programs on stream systems in Oklahoma that are statutorily designated as Scenic Rivers in the Oklahoma Scenic Rivers Act. There are no designated Scenic Rivers in the Panhandle.

Panhandle Action:

- It does not seem appropriate to implement an instream flow program in the Oklahoma Panhandle because of the very limited stream flows. Technical studies show that there is no longer a hydrologic connection between the Ogallala Aquifer and stream flow. The Panhandle Workgroup should monitor and participate in, as appropriate, the ongoing dialogue regarding instream/environmental flow programs in Oklahoma. Promote an emphasis on maintaining private property rights.

3.1.1.5 State/Tribal Water Consultation and Resolution

OCWP Recommendation: To address uncertainties relating to the water rights claims by the Tribal Nations of Oklahoma and to effectively apply the prior appropriation doctrine in the fair apportionment of state waters, the Oklahoma Governor and State Legislature should establish a formal consultation process as outlined in the OCWP Report on Tribal Issues and Concerns.

Applicability to the Panhandle: Tribal claims are focused on areas outside the Panhandle region.

Panhandle Action:

- Monitor the consultation process for any potential implications on Panhandle water management.

3.1.1.6 Water Conservation, Efficiency, Recycling and Reuse

OCWP Recommendation: To address water shortages forecasted in the 2012 Update of the Oklahoma Comprehensive Water Plan, as well as avoid the costly development of new supplies and infrastructure, the OWRB and other relevant agencies should collaborate with various representatives of the state's water use sectors – with particular emphasis on crop irrigation, municipal/industrial, and thermoelectric power – to incentivize voluntary initiatives that would collectively achieve an aggressive goal of maintaining statewide water use at current levels through 2060. In its associated evaluation of appropriate programs and policies, the state should identify the optimum financial incentives, as well as recognize the potential for lost water provider revenues resulting from improved conservation. In particular, the following should be considered:

- Implementation of incentives (tax credits, zero-interest loans, cost-sharing initiatives, increasing block rate/tiered water pricing mechanisms, etc.) to encourage improved irrigation and farming techniques, efficient (green) infrastructure, retrofitting of water-efficient infrastructure, use of water recycling/reuse systems in new buildings, promotion of "smart" irrigation techniques, control of invasive species, artificial recharge of aquifers, and use of marginal quality waters (including treated gray and wastewater).

- Expanded support for education programs that modify and improve consumer water use habits.
- The applicability of existing or new financial assistance programs that encourage Oklahoma water systems to implement leak detection and repair programs that result in reduced loss and waste of water.

Applicability to the Panhandle: The Panhandle has made major strides in the efficient use of available water supplies since water use in the region peaked in the 1970s. This has been accomplished through a combination of adopting new technologies, improved water management practices in the municipal and crop irrigations sectors, implementation of water recycling and reuse for both municipal and agricultural needs, and other efficiency principles and practices. The data summarized in this PRWP demonstrate how efficient water use can go hand-in-hand with economic vitality. Incentives and financial assistance programs for enhancement of water-efficient equipment and practices would be directly applicable to water users in the Panhandle. Stakeholders in the Panhandle are strongly supportive of state and local efforts to improve efficiencies measured on a unit basis (e.g., reducing the acre-feet of water needed to irrigate a certain crop, or reducing the per-capita demand rate for public water systems). However, that support generally does not extend to the concept of capping overall water use statewide or in any particular area – including the potential for unintended consequences such as impacts on the economic vitality of crop irrigation, industry, and communities in the Panhandle; involuntary transfers of supplies from agricultural uses to public water supply uses; incursion on private property rights.

Panhandle Action (through the Panhandle Workgroup):

- Seek direct representation and involvement in the water efficiency work group that is to be convened per the approved 2012 Water for 2060 legislation.
- Actively identify incentive programs that would be beneficial to – and used by – water users in the Panhandle region.
- Monitor continued discussions on and development of water efficiency incentive programs.
- Promote a culture of water efficiency locally, regionally, and statewide by reducing unit water demands, while allowing for the economic vitality and growth that is dependent on adequate water supplies without capping overall water use.
- Support the research, development, application, and implementation of water-efficient technologies and practices for all water use sectors in the Panhandle, as described further later in this section of the report.
- Support initiatives and seek funding to support eradication of salt cedar and other invasive species that reduce our available water supplies.

3.1.1.7 Water Supply Reliability

OCWP Recommendation: To address projected increases in water demands and related decreases in availability, as well as to ensure the fair, reliable, and sustainable allocation of Oklahoma's water supplies, the State Legislature should provide stable funding to the OWRB to implement the following recommendations:

- Address by 2022 the growing backlog of statutorily-required maximum annual yield studies and overdue 20-year updates on groundwater basins within the state, including validation of any interactions between surface and groundwater sources, to accurately determine water available for use.
- Develop stream water allocation models on all stream systems within the state to assess water availability at specific locations, manage junior/senior surface water rights under various drought scenarios, anticipate potential interference between users, and evaluate impacts of potential water transfers.
- Utilize water use stakeholders (including input from the recommended Regional Planning Groups), researchers, and other professionals to develop recommendations, where appropriate, regarding:
  - consideration of a seasonal (rather than annual) stream water allocation program to address seasonal surface water shortages and water rights interference;
  - consideration of a conjunctive management water allocation system to address the potential decline in surface water flows and reservoir yields resulting from forecasts of increased groundwater use in areas where these sources are hydrologically connected;
  - conditioning junior water use permit holders to discontinue their diversion of water during predetermined periods of shortage (i.e., "trigger" points) to enhance the availability of dependable yields in appropriate reservoirs and minimize interference between riparian users and users of reservoir storage; and
  - consideration of a more conservation-oriented approach in the calculation of groundwater basin yields and allocation of groundwater use permits, including the consideration of more sustainable use and development of groundwater supplies, allocation banking coupled with an accurate method of accounting, irrigation practice improvements, and adoption of new irrigation technology.

Applicability to the Panhandle: The Panhandle region's primary water supply source, the Ogallala aquifer, was studied by OWRB to establish the permanent maximum annual yield of 2 acre-feet per acre of dedicated land per year. That maximum annual yield is used by OWRB in issuing groundwater use permits for all users of the Ogallala aquifer in Oklahoma. The majority of the elements of this OCWP Priority Recommendation are focused on surface water permitting and administration of those permits. Although dry conditions are common and intermittent streams are the norm in the Panhandle, the extremely limited use of surface water in the Panhandle for beneficial uses severely limits the applicability of many of the components of this OCWP recommendation in the Panhandle. Conjunctive management of alluvial groundwater and surface water supplies is generally not applicable in the Panhandle, because both resources are scarce and cannot thus be effectively managed either individually or conjunctively. Changes in how the State calculates maximum annual yields and issues groundwater permits would have direct applicability to the Panhandle. Changes to the permitting process could ultimately affect existing and future private property rights, depending on how those changes were developed and implemented. Crop irrigators in the Panhandle are already employing water-efficient practices and irrigation equipment, as evidenced by the trends in water use and economic production described in this PRWP.

Panhandle Action:

- Monitor and actively participate in discussions regarding potential modifications to how maximum annual yields and permit allocations are calculated. Promote an emphasis on maintaining private property rights.
- Do not support statewide “one size fits all” programs that do not have technical application to the Oklahoma Panhandle and demonstrated results to extend the life of the Ogallala Aquifer. Programs should only be implemented after having been fully vetted by the Panhandle Workgroup.

3.1.1.8 <u>Water Quality and Quantity Monitoring</u>

OCWP Recommendation: The State Legislature should provide a dedicated source of funding to enable the State of Oklahoma to accurately assess the quality and quantity of its water resources, thereby ensuring improved water quality protection, accurate appropriation and allocation, and long-term collection of data to make informed water management decisions. Such funding should be directed toward development and maintenance of a permanent statewide water quality and quantity monitoring program(s), specifically allowing for the following:

- Integration of all state surface and groundwater quality monitoring programs into one holistic, coordinated effort.
- Stable and dedicated appropriations for critical statewide monitoring programs, such as Oklahoma’s Cooperative Stream Gaging Program, Beneficial Use Monitoring Program, and Nonpoint Source Monitoring Program, as well as other agency efforts to monitor point source, agriculture, mining, and oil and gas impacts.
- Creation of an ambient groundwater quality monitoring program.
- Full implementation of a statewide program for the collection of biological data to provide a better indication of long-term water quality trends in Oklahoma.

Applicability to the Panhandle: Water level measurements are taken and recorded on a recurring basis in hundreds of wells in the Panhandle, but water quality data are limited and often not compiled into any single database. Increased monitoring of water quality and supply availability in the Panhandle would be valuable to the Panhandle water users on a regional basis for both planning and operational reasons. However, a requirement to meter water use from all individual wells would be cost-prohibitive for most well owners.

Panhandle Action:

- Actively monitor and participate in discussions or work groups tasked with increasing water quality and supply availability monitoring across Oklahoma.
- Support efforts to identify funding for, and implementation of, the increased monitoring of water quality and water supply availability, while avoiding unfunded requirements for metering and other water use monitoring.
- Support educational efforts that show results of monitoring and technical initiatives to users of water in the Panhandle.

3.1.2 Supporting Recommendations and Initiatives

In addition to the OCWP priority recommendations, the OWRB also recommended a series of supporting recommendations and initiatives for water management in Oklahoma in the OCWP. Supporting recommendations and initiatives were developed in the following areas:

- Nonpoint Source Pollution,
- Maximizing and Developing Reservoir Storage,
- Water Management and Administration,
- Dam Safety and Floodplain Management,
- Water Quality Management,
- Navigation,
- Interstate Water Issues,
- Source Water Protection,
- Water Emergency/Drought Planning,
- Water Supply Augmentation,
- Water Related Research,
- Agricultural Water Research, and
- Climate and Weather Impacts on Water Management.

Several of these supporting recommendations are associated with issues that are largely inapplicable in the Panhandle. For example, navigation and reservoir storage are far more applicable to areas where surface water supplies are more significant and regularly available.

The recommendations and initiatives most in line with the long-term interests of the Panhandle water community include those that:

- Provide for research and funding into water-efficient practices, programs, and equipment;
- Allow for the continued protection of personal property rights;
- Better characterize the availability and quality of our existing water resources;
- Support local and regional-led planning processes; and
- Streamline the processes and administrative burden associated with the water permit process at the OWRB. The Panhandle Workgroup should work with the OWRB and identify those areas that can and should be reduced, changed or removed.

Key elements of these supporting recommendations and initiatives are summarized along with other Panhandle water management strategies in Section 3.2.

3.2 PANHANDLE WATER MANAGEMENT STRATEGIES FOR ECONOMIC VITALITY

In developing the PRWP, the PRWP Steering Committee discussed a range of potential Water Management Strategies. These were also the subject of an August 2012 public meeting held in the Panhandle as part of the PRWP. Toward a common goal of maintaining the efficient use of available supplies and ongoing economic vitality, the following provides an overview of the areas recommended for focused assessment and implementation for the Panhandle region.

- **Research and Development (drought-tolerant crops, alternative crops, efficient irrigation technologies):** Because crop irrigation is the largest component of Panhandle water use, research and development into ways to further increase water use efficiencies will provide the most significant results. Ongoing support for the development of these technologies will help the Panhandle continue to maintain its economic vitality, while reducing the unit water consumption required to produce crops.
- **Invasive Species Eradication:** Water users in the Panhandle and throughout the state have a vested interest in removing invasive species such as salt cedar, to reduce their draw on surface water and alluvial groundwater supplies and increase their availability for beneficial uses. Support for legislative and other sources of funding should be sought to support eradication of these species in the Panhandle.

- **Oklahoma Panhandle State University and Oklahoma State University Research Priorities:** As two of the leading agricultural research groups in the south-central U.S., OPSU and OSU have the ability to make solid contributions toward the long-term economic vitality of the Panhandle.
- **Streamlined Permitting:** Streamline the processes and administrative burden associated with the water permit process at the OWRB. The Panhandle Workgroup should work with the OWRB and identify those areas that can and should be reduced, changed or removed.
- **Additional Groundwater Data Collection:** As discussed previously in this section, enhancements and regular updates to groundwater quality databases would provide an invaluable resource to planners and managers in the area.
- **Regulatory Relief:** Increasing regulation and permitting can constrain the wise use of available supplies. In particular, the City of Guymon is seeking regulatory relief from ODEQ to allow the intentional recharge of its potable water source lake with treated effluent.
- **Water Reuse Programs and Incentives:** With the recently adopted ODEQ regulations for non-potable water reuse, there is increased awareness of the role that recycled water can play in a water portfolio. Continued development of programs and incentives for increased water reuse will help communities like Guymon extend their use of raw and potable water supplies. The Panhandle Regional Water Planning Workgroup should actively support Guymon's efforts to secure regulatory approval from ODEQ for augmentation of Sunset Lake with reclaimed water and other innovative ways to reuse the area's limited water resources for beneficial use in Guymon and communities throughout the Panhandle.
- **Cost Share Opportunities:** Panhandle water users should continue to seek out partnerships and cost share opportunities, with both federal agencies and state agencies, to leverage the use of limited local funds that may be available.
- **Low-Interest Loans for Water and Wastewater:** Existing loan programs, such as the OWRB Financial Assistance Program, provide low-interest loans. However, the current levels of federal funding for the State Revolving Fund loan program and other federal programs are significantly smaller than the financial needs identified in the OCWP. Increasing the availability of low-interest loans would help utilities implement projects they need to comply with regulations and other mandates, while keeping rates affordable for their customers.
- **Information Sharing and Education Opportunities for Irrigators:** OPAI provides a network of irrigators, where common issues can be discussed and addressed. Increased opportunities to share information between water users and to increase education opportunities for wise water use can help further promote the Panhandle water users' goals.

- **Information Sharing and Education Opportunities for Municipal Water Users:** Public water suppliers often face the same types of technical, regulatory, and operational issues as their neighbors. Increasing networking opportunities will directly benefit the utilities and their customers, building on the relationships and networking established today through PREDCI.

Appendix A

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