Section 5

Summary and Conclusions

During 2006 and 2007, there have been announcements, with initiation of implementation, of three 110 million gallons per year capacity and one 50 million gallons per year capacity ethanol plants in the Llano Estacado Water Planning Region (Region O). In addition, there are regular announcements of new dairies being located in the water planning region. These are new industries for the region, for which water supplies have not been included in previous regional water plans for either the industries, the associated population that will supply the labor, nor the input support industries. The purposes of this study were to (1) estimate population and water demands for new ethanol plants and expanded numbers of dairies of the Llano Estacado Water Planning Region, (2) evaluate water supplies and desalination costs of Dockum Aquifer water, and (3) identify and describe video conferencing facilities available for coordination between Regions A and O. A summary of the results is presented below.

Ethanol Plants: As of 2008, two of the 110 million gallons per year ethanol plants are located at Hereford in Deaf Smith County, one 110 million gallons per year plant is located near Levelland in Hockley County and the 50 million gallons per year plant is located at Plainview in Hale County of the Llano Estacado Water Planning Region. The combined water requirements of these four plants are about 3.5 million gallons per day, or 3,920 acre-feet per year.

Dairies and Dairy Cattle: The number of dairies has grown from 37 in 2006 to 59 in 2008, the estimated number of dairy cattle has increased from about 55,000 in 2005 to 130,498 head in 2008, and milk production has increased from 4.14 million pounds per day in 2005 to 9.00 million pounds per day in March 2008. The projected number of head of dairy cattle in the eight-county area has been revised to 155,750 in 2010, 188,544 in 2020, and 280,714 head in 2060.

Water Demand Changes for Dairies: Water demand for dairies is projected to increase from about 6,256 acre-feet per year in 2010 to a revised projection of 8,374 acre-feet per year in 2010. For 2030, revised projections are 11,198 acre-feet per year compared to the 2006 Regional Water Plan projections of 11,427 acre-feet per year in

2030, and for 2060 are 15,093 acre-feet per year, compared to the 2006 Regional Water Plan projection of 11,427 acre-feet per year in 2060. Revised projections of drinking water for dairy cattle and dairy milking parlor sanitation demands were based upon 48 gallons per cow per day instead of the 65 gallons per cow per day of the 2006 Regional Water Plan, and results in lower quantities of water demand for these purposes for the period of 2017 through 2033 than was projected for the 2006 Regional Water Plan, however, the revised projected water demand for dairies for 2060 is 15,093 acre-feet per year compared to the 2006 Water Plan projection of 11,587 acre-feet per year.

Water Demand Changes for Dairy Workers and Associated Population: In the case of municipal water demand, the increased dairy production is projected to result in a larger number of dairy workers and their associated family members, resulting in an increased municipal water demand of 466 acre-feet per year for the increased population of 2,405 in 2010, increased municipal demand of 182 acre-feet per year in 2020, and for 2060 an increased demand of 769 acre-feet per year for the increased projected population of 4,255.

Water Demands for Dairy Cattle Feed Production: The irrigation water requirements for feed production for the revised dairy projections are 16,938 acre-feet per year higher in 2010, 20,504 acre-feet per year higher in 2020, 25,019 acre-feet per year higher in 2040, and 30,528 acre-feet per year higher in 2060.

Increased Demand for Water for Ethanol Plants, Dairies, and Associated Population: The total increased water demand for ethanol production, dairies, dairy population and dairy feed production is 23,362 acre-feet per year in 2010, of which 16.7 percent is for ethanol production, 8.7 percent is for dairies, 2.0 percent is for dairy worker population, and 72.5 percent is for dairy feed production. The total is 30,166 acre-feet per year in 2040, and 38,723 acre-feet per year in 2060, of which ethanol production is 10.1 percent, dairies are 9.1 percent, dairy worker population is 1.98 percent, and dairy feed production is 78.8 percent.

Water Supply Potentials and Costs of Raw Water from the Dockum Aquifer: A potential supply of additional water in Bailey, Castro, Deaf Smith, Hale, and Parmer Counties is in the Dockum Aquifer which lies underneath the Ogallala Aquifer. The Dockum Aquifer has experienced little development except in areas where it is relatively shallow. Recharge to the Dockum in the study area consists of precipitation and streamflow losses in areas where the sediments are exposed at the land surface toward the northwest in New Mexico and Texas and downward leakage from the overlying Ogallala. The potential for a significant amount of recharge is extremely limited.

The best water bearing zone of the Dockum is sandstone in the lower part of the aquifer. Dockum wells in the vicinity of Hereford and in northeast Castro County typically are 800-950 ft deep. The deepest well depths would be about 1,400 ft in Lamb County. Typical well yields of Dockum wells is estimated to range from about 400 gpm in the Deaf Smith County area to about 200 gpm in the southern part of the study area. The salinity of water in the Deaf Smith County area typically ranges from concentrations of 800 to 1,500 milligrams per liter of total dissolved solids. In southern part of the study area, the salinity is greater than 20,000 mg/L of total dissolved solids.

It is estimated that there are nearly 85 million acre-feet of groundwater in the Dockum in this six county area, with the greatest amount of groundwater in storage with a salinity of 5,000 mg/L or less occurring in Deaf Smith County. Bailey and Lamb Counties have a considerable volume of Dockum groundwater, but the salinity is estimated to be mostly greater than 20,000 mg/L. Potential well field designs were prepared for two well fields (Deaf Smith and Parmer-Castro-Lamb County) and at three pumping rates (0.2, 1, 3, and 10 million gallons per day (MGD). The most economical water supply, not considering water treatment, was from the Deaf Smith well field pumping at a rate of 3 MGD. The delivery of raw water to a terminal near the well field is estimated to cost about $305 per acre foot.

Costs of Desalting Water from the Dockum Aquifer: Costs were estimated for desalination using Reverse Osmosis (RO) and concentrate disposal using solar evaporation and deep well injection for 0.2 MGD, 1 MGD, 3 MGD, and 10 MGD sized Dockum Aquifer well fields having 1,500, 3,000, 5,000, and 20,000 mg/L concentrations of TDS.

Desalination Costs: Estimated desalination costs for water with 1,500 mg/L range from $2.53 per 1,000 gallons for a .02 MGD facility, to $1.49 per 1,000 gallons for a 1 MGD facility, to $1.11 per 1,000 gallons for a 3 MGD facility, and $0.88 per 1,000 gallons for a 10 MGD facility. Estimated desalination costs for water with 3,000 mg/L range from $2.90 per 1,000 gallons for a .02 MGD facility, to $1.74 per 1,000 gallons for a 1 MGD facility, to $1.31 per 1,000 gallons for a 3 MGD facility, and $1.06 per 1,000 gallons for a 10 MGD facility. Estimated desalination costs for water with 5,000 mg/L range from $3.41 per 1,000 gallons for a .02 MGD facility, to $1.97 per 1,000 gallons for a 1 MGD facility, to $1.51 per 1,000 gallons for a 3 MGD facility, and $1.23 per 1,000 gallons for a 10 MGD facility. Estimated desalination costs for water with 20,000 mg/L range from $4.74 per 1,000 gallons for a .02 MGD facility, to $2.77 per 1,000 gallons for a 1 MGD facility, to $2.14 per 1,000 gallons for a 3 MGD facility, and $1.75 per 1,000 gallons for a 10 MGD facility.

Concentrate Disposal Costs using Solar Evaporation: Estimated concentrate disposal costs using solar evaporation for water with 1,500 mg/L range from $1.48 per 1,000 gallons for a 0.2 MGD facility, to $1.15 per 1,000 gallons for a 1 MGD facility, to $1.03 per 1,000 gallons for a 3 MGD facility, and $1.04 per 1,000 gallons for a 10 MGD facility. Estimated concentrate disposal costs using solar evaporation for water with 3,000 mg/L range from $2.41 per 1,000 gallons for a 0.2 MGD facility, to $1.91 per 1,000 gallons for a 1 MGD facility, to $1.79 per 1,000 gallons for a 3 MGD facility, and $1.72 per 1,000 gallons for a 10 MGD facility. Estimated concentrate disposal costs using solar evaporation for water with 5,000 mg/L range from $3.18 per 1,000 gallons for a 0.2 MGD facility, to $2.63 per 1,000 gallons for a 1 MGD facility, to $2.44 per 1,000 gallons for a 3 MGD facility, and $2.38 per 1,000 gallons for a 10 MGD facility. Estimated concentrate disposal costs using solar evaporation for water with 20,000 mg/L range from $5.30 per 1,000 gallons for a 0.2 MGD facility, to $4.75 per 1,000 gallons for a 1 MGD facility, to $4.45 per 1,000 gallons for a 3 MGD facility, and $4.27 per 1,000 gallons for a 10 MGD facility.

Concentrate Disposal Costs using Deep Well Injection: Estimated concentrate disposal costs using deep well injection for water with 1,500 mg/L range from $9.75 per 1,000 gallons for a 0.2 MGD facility, to $2.03 per 1,000 gallons for a 1 MGD facility, to $0.71 per 1,000 gallons for a 3 MGD facility, and $0.44 per 1,000 gallons for a 10 MGD facility. Estimated concentrate disposal costs using deep well injection for water with 3,000 mg/L range from $10.63 per 1,000 gallons for a 0.2 MGD facility, to $2.22 per 1,000 gallons for a 1 MGD facility, to $0.83 per 1,000 gallons for a 3 MGD facility, and

$0.59 per 1,000 gallons for a 10 MGD facility. Estimated concentrate disposal costs using deep well injection for water with 5,000 mg/L range from $11.47 per 1,000 gallons for a 0.2 MGD facility, to $2.48 per 1,000 gallons for a 1 MGD facility, to $1.64 per 1,000 gallons for a 3 MGD facility, and $1.04 per 1,000 gallons for a 10 MGD facility. Estimated concentrate disposal costs using deep well injection for water with 20,000 mg/L range from $13.98 per 1,000 gallons for a 0.2 MGD facility, to $3.01 per 1,000 gallons for a 1 MGD facility, to $2.12 per 1,000 gallons for a 3 MGD facility, and $1.88 per 1,000 gallons for a 10 MGD facility.

Estimated Total Costs of Water from the Dockum Aquifer: Estimated total costs for raw water, desalination, and concentrate disposal for water from the Dockum Aquifer with TDS of 1,500 mg/L range from $5.35 per 1,000 gallons for a 0.2 MGD size facility, to $3.76 per 1,000 gallons for a 1 MGD facility, to $2.75 per 1,000 gallons for a 3 MGD facility, and $2.29 per 1,000 gallons for a 10 MGD facility. Estimated total costs for raw water, desalination, and concentrate disposal for water from the Dockum Aquifer with TDS of 3,000 mg/L range from $6.65 per 1,000 gallons for a 0.2 MGD size facility, to $4.77 per 1,000 gallons for a 1 MGD facility, to $3.07 per 1,000 gallons for a 3 MGD facility, and $2.61 per 1,000 gallons for a 10 MGD facility. Estimated total costs for raw water, desalination, and concentrate disposal for water from the Dockum Aquifer with TDS of 5,000 mg/L range from $7.94 per 1,000 gallons for a 0.2 MGD size facility, to $5.57 per 1,000 gallons for a 1 MGD facility, to $4.08 per 1,000 gallons for a 3 MGD facility, and $3.23 per 1,000 gallons for a 10 MGD facility. Estimated total costs for raw water, desalination, and concentrate disposal for water from the Dockum Aquifer with TDS of 20,000 mg/L range from $11.44 per 1,000 gallons for a 0.2 MGD size facility, $7.21 per 1,000 gallons for a 1 MGD facility, to $5.62 per 1,000 gallons for a 3 MGD facility, and $5.10 per 1,000 gallons for a 10 MGD facility.

Interactive Video Conferencing Facilities: Fully staffed interactive video conferencing facilities and services, with capabilities to meet the needs of Regions A and O are in existence and are available to both Regions A and O at Offices of the AgriLife Research Facilities of the Texas A&M University System in Amarillo and Lubbock, respectively. Consequently it appears that justification can not be made at this time for the purchase and installation of such facilities. It is suggested that Regions A and O schedule an Interactive Video Conferencing demonstration using the AgriLife Research facilities at Lubbock and Amarillo in order to test the functionality of Interactive Video Conferencing for interregional coordination. If the services available are satisfactory, then it will not be necessary to give further consideration to purchase and installation of such facilities.

Conclusions: The revised projections of water demand for the ethanol and expanded dairy water using sectors, as presented in this report, are available for use in development of the 2011 Llano Estacado Regional Water. The results of the Dockum Aquifer water supply and desalt cost analyses provide information as to potential sources, quantities, and costs of water for consideration in the development of water management strategies to meet some local municipal and industrial needs.

Interactive videoconferencing services are readily available, at negligible costs, for use by Regions A and O for coordination of regional water planning.