

## Exhibit 2006 Groundwater Pumping Estimates

**Table 1 - Acres Irrigated by Groundwater in 2006**

Item	County (or portion of County in the Republican River Basin study area)								
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sprinkler	10,635	152,487	2,367	5,721	68,100	21,984	37,450	267,639	566,385
Flood	102	1,893	0	0	2,262	584	0	1,183	6,024
<b>Total</b>	<b>10,737</b>	<b>154,380</b>	<b>2,367</b>	<b>5,721</b>	<b>70,362</b>	<b>22,568</b>	<b>37,450</b>	<b>268,822</b>	<b>572,409</b>

Source: 2005 Aerial Photographs

**Table 2 - Efficiency Factors for Estimating Pumping In Colorado**

Year	Percent of CIR Met by Pumping (%)	Sprinkler Irrigation			Flood/Gated Pipe/Furrow Irrigation		
		Maximum Farm Efficiency (%)	Pumping Lost to Spray Loss (%)	Pumping to Deep Percolation (%)	Maximum Farm Efficiency (%)	Net Surface Water Runoff (%)	Pumping to Deep Percolation (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2006	75%	80%	3%	17%	65%	5%	30%

Source:

- (2) Data from "150 Well Water Right Change Study" (See Table 5 of Helton & Williamsen memorandum entitled )
- (3) Estimated
- (4) Estimated
- (5) Calculated as 100% - Column(3) - Column(4)
- (6) Estimated
- (7) Initial surface water runoff is estimated to be 10%. Estimated that 5% deep percolates back into aquifer after it leaves the end of the field and 5% returns to the stream or is consumed.
- (8) Calculated as 100% - Column(6) - Column(7)

**Table 3 - Crop Irrigation Requirement (units of inches)**

Year	County (or portion of County in the Republican River Basin study area)									Weighted Average Using Acres in Table 1
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
2006	19.04	17.85	19.77	23.69	20.55	21.90	23.06	18.36	19.01	

Sources:

- Potential consumptive use estimated using the Hargreaves equation calibrated to the Penman-Monteith equation.  
 Effective rainfall estimated using procedure outlined in TR-21.  
 Crop mix from NASS data was used to weight the CIR for each county.  
 See memorandum by Helton & Williamsen entitled "Crop Consumptive Use Requirements - Republican River Basin in Colorado" dated November 19, 2002.

**Table 4 - Gain in Soil Moisture from Winter and Spring Precipitation (units of inches)**

Year	County (or portion of County in the Republican River Basin study area)									Average
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
2006	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	

Source:

- 1) "Republican River Basin Water Management Study - Working Paper - Farm Water Management", Steven J. Vandas, United States Bureau of Reclamation, March 1983
- 2) As a check on reasonableness  
 Average Monthly Precipitation for Yuma County in April and May = 4.8 inches  
 Average Monthly Consumptive Water Requirement for Corn Grain in Yuma County in April and May = 1.2 inches  
 Which results in 4.8" - 1.2" = 3.6" of precipitation that becomes surface water runoff, deep percolation, soil evaporation, or a gain to soil moisture storage.

**Table 5 - Net Crop Irrigation Requirement (units in inches)**

Year	County (or portion of County in the Republican River Basin study area)									Weighted Average Using Acres in Table 3
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
2006	17.04	15.85	17.77	21.69	18.55	19.90	21.06	16.36	17.01	

Calculated as Table3 minus Table 4

**Table 6 - Irrigation Groundwater Pumping (acre-feet)**

Year	County (or portion of County in the Republican River Basin study area)									Total
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Sprinkler	14,161	188,786	3,286	9,693	98,696	34,171	61,622	342,084	752,499	
Flood	167	2,885	0	0	4,035	1,117	0	1,861	10,065	
<b>Total</b>	<b>14,328</b>	<b>191,671</b>	<b>3,286</b>	<b>9,693</b>	<b>102,731</b>	<b>35,287</b>	<b>61,622</b>	<b>343,945</b>	<b>762,564</b>	

For each county pumping is calculated as

Sprinkler Pump = Sprinkler Irrig Acres (Table 1) x % CIR (Table 2, column2) x Net CIR/12 (Table 5) / Sprinkler Efficiency (Table2, column3)  
 Flood Pump = Flood Irrig Acres (Table 1) x % CIR (Table 2, column2) x Net CIR/12 (Table 5) / Flood Efficiency (Table2, column6)

**Table 7 - Recharge From Groundwater Pumping in Colorado (acre-feet)**

Year	County (or portion of County in the Republican River Basin study area)									Total
	Cheyenne	Kit Carson	Lincoln	Logan	Phillips	Sedgwick	Washington	Yuma		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Sprinkler	2,407	32,094	559	1,648	16,778	5,809	10,476	58,154	127,925	
Flood	50	865	0	0	1,210	335	0	558	3,019	
<b>Total</b>	<b>2,458</b>	<b>32,959</b>	<b>559</b>	<b>1,648</b>	<b>17,989</b>	<b>6,144</b>	<b>10,476</b>	<b>58,713</b>	<b>130,944</b>	

For each county recharge is calculated as

Sprinkler Recharge = Sprinkler Pump (Table 6) x Sprinkler Pump to Deep Percolation (Table2, column5)  
 Flood Recharge = Flood Pump (Table 6) x Flood Pump to Deep Percolation (Table2, column8)