Kansas v. Nebraska & Colorado
No. 126, Orig., U.S. Supreme Court

Engineering Analysis of Losses to Kansas Water Users from Nebraska's Overuse of Republican River Water in 2005 and 2006

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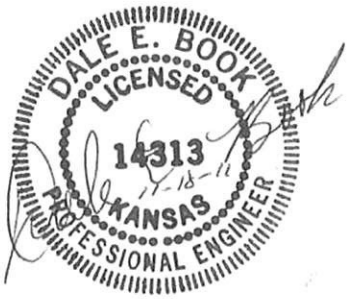

November 18, 2011

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1.0 Introduction

This report describes the analysis of reduced water supply to the State of Kansas caused by overuse of Nebraska's allocation on the Republican River for the years 2005 and 2006. The Republican River Compact allocates the available water supply of the Republican River Basin among the States of Kansas, Nebraska and Colorado. The Final Settlement Stipulation (FSS) and Accounting Procedures, approved in the Supreme Court's Decree of May 19, 2003, specify the methods to be used to quantify each State's Computed Beneficial Consumptive Use (CBCU) and allocation. For Water-Short Years, a two-year test of compliance is specified, in which the Nebraska CBCU upstream of Guide Rock is compared to the Nebraska allocation upstream of Guide Rock. Nebraska was not in compliance with the Water-Short Year test for 2005 and 2006. The analysis presented in this report was developed to determine how the water supply unavailable to the State of Kansas due to overuse in Nebraska for the two years would have been used if Nebraska had been in compliance with the FSS.

Nebraska's overuse upstream of Guide Rock for the two years totaled 78,960 acre-feet. This overuse was computed for the two years from the RRCA compact accounting (see Attachment 1). The figure for 2005, 42,860 acre-ft, has been agreed to by the States in the "Stipulation of the States Concerning Accounting of Overuse by Nebraska." Nebraska's overuse for 2006 has not been agreed to by the States, due to differences in allocation of reservoir evaporation for Harlan County Reservoir (HCR) and whether the Accounting Procedures, as applied to 2005 and 2006, should be changed. The total amount of HCR evaporation for 2006 is not in dispute. Nebraska's five-year compact compliance status is shown on Attachment 2. The year 2007 was a Water-Short year for purposes of FSS accounting. Nebraska's overuse for the two years 2006 and 2007 totaled 26,150 acre-feet. Attachment 3 provides the Water-Short year accounting for these years. The figures for 2007 are based on data submitted by the states to the RRCA and accounting pursuant to the Accounting Procedures.

The overuse in Nebraska for 2005 and 2006 reduced the water supply available to the Kansas Bostwick Irrigation District (KBID). The KBID water supply from the Republican River is diverted at Guide Rock, in Nebraska, through the Courtland Canal. KBID receives direct flows from the Republican River and water from storage in HCR. KBID shares water diverted at Guide Rock with the Nebraska Bostwick Irrigation District (NBID). NBID has irrigated land north of the river under the Superior Canal and south of the river under the Courtland Canal. The actual water supply available to KBID for 2005 and 2006 was limited by the water in storage at HCR, such that, had Nebraska's total overuse been available at Guide Rock, it would have been used by KBID. This

analysis derived the amount of water that would have been delivered to water users in the KBID service area. The additional supply would also have produced additional streamflow in the Republican River at Hardy and downstream of KBID lands, which would have resulted in additional diversions for use in Kansas. Finally, additional flow would have reached Milford Reservoir downstream in Kansas. The results of this investigation have been provided to the Kansas economists for the purpose of computing economic losses to the state of Kansas due to the shortages caused by overuse in Nebraska.

The analysis included the following components:

1. Determine the additional supply available to Kansas at the Stateline by deducting additional reservoir evaporation and transit loss between the Courtland Canal headgate and the Stateline.

2. Compare the available supply with the normal demand and existing supply in KBID.

3. Determine the amount of increased water supply at the farm in KBID, based on estimates of system losses in the Courtland Canal system.

4. Determine the additional return flows to the Republican River at Hardy and below KBID and the amounts that would have been diverted by downstream water users.

2.0 Description of KBID System

The Courtland Canal diverts from the Republican River near Guide Rock, Nebraska and delivers water to the KBID service area, located in Jewell and Republic Counties, west of Republic (See Figure 1). The total service area is approximately 43,000 acres. Lovewell Reservoir, with a maximum capacity of approximately 56,000 acre-feet, is located in the service area and reregulates the Republican River supply from Courtland Canal. The service area consists of the upper section, approximately one-third of the service area above Lovewell, and the lower section, which receives water out of Lovewell. The Courtland Canal has a capacity of 530 cfs at the Nebraska Stateline and 440 cfs downstream of Lovewell. Courtland Canal is also operated at times outside of the irrigation season to supply water to Lovewell when needed. During the irrigation season, releases from HCR are made at the request of KBID and NBID.

During 2005 and 2006, some of the service area in KBID did not receive water due to severe water supply shortages. USBR records document 24,500 acres irrigated in 2005

and 28,600 acres irrigated in 2006. For the lands actually receiving water, an average of approximately 6.9 inches were delivered in 2005 and 2006. KBID's base allocation is 15 inches.

Figure 1 shows the location of the Courtland Canal, the KBID service area and the Republican River below KBID lands. Return flows from the Courtland Canal and the KBID service area reach the Republican River and tributaries and are available for diversion or recharge to the alluvial aquifer downstream.

3.0 Additional Losses Above Stateline

It was assumed that the additional 78,960 acre-feet supply to Kansas would have been regulated through HCR. For purposes of this analysis, canal and lateral seepage and wasteway discharges and reservoir seepage and evaporation are collectively referred to as system losses. Based upon historical, 1994 – 2006, evaporation and supply data from the Bureau of Reclamation (BOR), the additional amount of evaporation was determined. BOR data for HCR are summarized in Appendix A. Gross evaporation was assumed to be a function of the HCR supply available before July of any given year. A relationship between gross and net evaporation rates was obtained independent of the supply. Over the two-year period, the additional supply to HCR would have resulted in an increase of approximately 4,000 acre-feet of net evaporation, assumed to be allocated to Kansas.

Additional transit losses in Nebraska would have also occurred due to the additional supply. An analysis was made to calculate the additional loss in the Courtland Canal with the additional supply added to the historical diversions (Appendix B).

The historical record, 1994 – 2007, was divided into two seasons, irrigation (May – September) and non-irrigation (October – April). Total volumes for the summer season were calculated and a relationship of canal loss to diversions was developed for the historical record (Appendix B-1). Appendix B-2 summarizes the summer season diversions, Stateline delivery and calculated loss. Courtland Canal loss was calculated as the difference between the headgate diversion and Stateline flow, less any water diverted by NBID.

The additional water was assumed to be delivered to Kansas during the irrigation season. The relationship of loss and diversions was applied to the total diverted volume of water. The additional supply, after deducting the additional HCR evaporation and Courtland Canal transit loss, was added to the historical seasonal diversions, which resulted in adjusted diversions, measured at the Stateline, of 59,382 acre-feet in 2005 and 56,585 acre-feet in 2006. Loss was calculated based on the relationship developed in the curve

shown in Appendix B-1. The curves and adjusted values are plotted with the historical values in Appendix B-1. The resulting additional volume of water delivered at the Stateline for diversion by KBID was 37,776 acre-feet in 2005 and 31,677 acre-feet in 2006. Appendix B-3 summarizes the results of the Courtland Canal loss analysis from Guide Rock to the Stateline, historical and adjusted.

Applying the assumptions in the RRCA Accounting, 18% of the Courtland Canal loss in this reach would be consumed. Of the 5,449 acre-feet of additional loss calculated, this would be approximately 1,000 acre-feet or approximately 500 acre-feet/year. Therefore, approximately 4,500 acre-feet of the total loss would eventually reach the Republican River above the Hardy gage as stream gain and be available for diversion by users in Kansas located on the mainstem, assuming no additional water would be diverted by users in Nebraska.

Additional evaporation and transit losses allocated to the State of Kansas and the resulting net Stateline supply were as follows:

Additional Losses in Nebraska Assigned to Kansas
(2005 – 2006)
(acre-feet/year)

Year	Additional Supply	Additional HCR Evaporation	Additional Transit Losses in NE	Net Available Stateline Supply
2005	42,900	1,300	3,800	37,800
2006	36,100	2,700	1,700	31,700

Note: Figures are rounded.

4.0 Analysis of Additional Water Supply to KBID for 2005 and 2006

The amount of water available to KBID at the Stateline through the Courtland Canal, if Nebraska use had been within its allocation for the two years, was allocated to farm deliveries and system losses. Historical operational records were used to compute the efficiency of the Courtland Canal system to deliver water to the users served with project water in KBID. The additional water available to KBID water users at the farms was computed, using the efficiencies for canal, lateral and Lovewell Reservoir operations derived from historical records.

Records are available for water delivered into each of the two KBID sections (above and below Lovewell), discharges from canal and lateral wasteways, deliveries to the farms

and computed canal loss. KBID also reports the acreage receiving water each year. These data for the period of 1994 - 2007 were compiled and used to derive loss relationships for each component, as a function of supply. This period was selected to provide a reasonable number of years with facilities and operations at current conditions in the district. Data for KBID water use over this period are included in Appendix C.

System efficiencies were developed separately for deliveries of water in the Upper and Lower KBID service area. Deliveries for the two years, as obtained from the Bureau annual reports, were as follows:

USBR Data
(2005 and 2006)

Upper KBID	2005	2006
Acres	1,107	5,925
Deliveries (acre-feet/yr)	561	3,353
Inches	6.1	6.8
Lower KBID		
Acres	23,439	22,655
Deliveries (acre-feet/yr)	12,040	14,610
Inches	6.2	7.7
Total KBID		
Acres	24,546	28,580
Deliveries (acre-feet/yr)	12,601	17,963
Inches	6.2	7.5

The acreage normally irrigated in KBID and farm deliveries, when adequate water supply is available to KBID, are indicated by supplies from 1994 to 2000. These averaged 38,000 acres and 13.5 inches per year over that period, or about 42,800 acre-feet/yr. Actual deliveries for 2005 and 2006 were approximately 29% and 42% of normal, respectively.

The system efficiency for delivery of the additional water supply to the farms was based on the delivery efficiency for the total supply. This was determined by applying the efficiencies derived from historical delivery records to the water supply that would have been available to KBID. Relationships of losses to water supply were derived separately

for canal, lateral and Lovewell Reservoir (see Figures 2-6). It was necessary to allocate deliveries for the two sections above and below Lovewell, since the system losses are different for deliveries to each section, and reservoir losses are incurred for water delivered to the lower section. The historical data were used to determine this allocation. The total amount of water that would have been delivered to the farms in each of the two sections does not depend on the actual acreage assumed to have been irrigated in each, but would be dependent upon the allocation between the two sections. The amount of acreage irrigated was determined by the economists, based on the available supply and historical acreage.

The analysis was made on a seasonal basis. The water supply for KBID is regulated through reservoir storage, providing KBID with the ability to use allocations when needed. Typically, KBID water users take water during the months of May through September. It has been assumed that the water would be available to KBID from HCR during the irrigation season and reregulated through Lovewell as needed.

The percentage of canal loss was obtained from the relationships shown in Figures 2 and 4. Lateral losses were determined to be 40% above Lovewell and 37% below Lovewell, based on the relationship of historical records shown in Figures 3 and 5.

Some loss of water delivered to Lovewell Reservoir for use in the lower Section would have occurred. This was estimated based on historical relationship of reservoir loss to supply. Annual losses were compared to supply, as shown on Figure 6.

Additional water supply computed to be available to KBID was added to the existing supply. The relationships of losses to water supply were used to compute canal, lateral and reservoir loss. After deducting these losses, the remaining supply available to the farms was computed. The records used for historical KBID operations were those prepared by the USBR, and indicated a small amount of delivery to the section above Lovewell in 2005, although the KBID records indicated no delivery in this section.

5.0 Summary of Additional KBID Supply

For the two years, the combined additional supply at the Stateline was 69,500 acre-feet. After deducting losses, the farm deliveries for the two years would have increased by approximately 39,000 acre-feet. Additional delivery to farms was computed to be 20,900 acre-feet in 2005 and 18,100 acre-feet in 2006. Tables 1-3 summarize the results of the analysis of additional supply to KBID.

6.0 Return Flows from the Courtland Canal in Nebraska and KBID

Water deliveries to KBID cause stream gains below Guide Rock due to return flows downstream of the Courtland Canal and the District lands on the Republican River and tributaries. Return flows result from canal, lateral and field losses. Return flows consist of surface flows and deep percolation reaching the streams. Surface returns, termed wasteway flows, are measured and reported for the KBID service area. Return flows were computed as the sum of canal and lateral losses, combined with on-farm return flows, computed from estimated irrigation efficiencies. Return flows resulting from the additional water use on KBID lands would have been available for diversion to non-KBID farms located below the District, downstream to Clay Center, Kansas in Clay County.

The canal and lateral losses attributed to the additional water supply were determined as described above. To determine the amount of return flow, 18% was deducted from the farm, canal and lateral losses (excluding measured wasteway discharge), to account for evaporation.

The return flows attributed to seepage and deep percolation from KBID lands in large part are collected and discharged through drains constructed in the service area. During the 1960s the USBR started installing drainage systems in KBID. After the USBR drainage program ended in the 1980s, the District installed additional drains. There are approximately 300 miles of drains located throughout the KBID service area.

The amount of return flows generated by the additional supply that would have been available to the downstream water rights within the irrigation seasons of 2005 and 2006 depends on the timing for flows to reach the streams. An analysis was made to determine approximate timing for the groundwater return flows from District lands to accrue to the streams. The purpose of this analysis was to confirm that the return flows would have been available in the streams at sufficient rates to supply the additional diversions that would have occurred, as derived below. An analytical method, which considers the geologic properties of the aquifers and the distance from the service area to the tributary streams and river, was used for this purpose. The primary parameters necessary for the analysis are transmissivity and distance. The distance of groundwater flow depends on drainage conditions.

Where artificial drains have been installed the travel time is reduced significantly when compared to natural conditions. The drains in the service area discharge return flows relatively soon after water is applied. Parameters were developed for both drained conditions and natural, undrained, conditions. It was assumed for the analysis that 75%

of the lands in KBID were drained by constructed drains. Information obtained from the District indicates that effectively most of the District lands are served by constructed drains.

The analytical method, referred to as the Glover method (Glover, 1977), was applied to determine the timing of return flows to the stream system generated by additional water supply delivered to the KBID lands. The elements of return flows included canal and lateral seepage and farm return flows. The parameters for the analysis were derived from available reports documenting aquifer parameters. The distances used in the analysis were developed from mapping of the service area. Weighted distances and aquifer parameters were derived for the Upper and Lower sections of KBID. Appendix D summarizes the inputs used in the analysis. Return flows were separated between surface water (wasteway discharge) and deep percolation. Return flow schedules were developed for drained and undrained conditions. Separate schedules were developed for the Upper and Lower sections of KBID.

Return flows from lands that are drained were determined to reach the stream within a short period of time, effectively within two months of occurrence. For areas that may not be drained, the timing is longer due to the distance to the streams and aquifer characteristics.

Total return flows from KBID attributable to the additional supply, were computed to be approximately 15,000 acre-feet in 2005 and approximately 12,300 acre-feet in 2006. During the irrigation season, the volume of increased return flow reaching the tributaries and river was 14,775 acre-feet, at rates up to 49 cfs for 2005, and 11,540 acre-feet, at rates up to 38 cfs for 2006. Results are summarized in Appendix D.

Republican River water rights in Kansas were under Minimum Desirable Streamflow (MDS) administration the entire 2005 and 2006 period. MDS requirements are part of the Kansas Water Appropriation Act. When flows drop below established thresholds, water rights granted after 1984 are subject to diversion or pumping restrictions. The additional water from KBID return flows were added to historical flows at Concordia and compared to MDS for the period. Based on records and discussions with Kansas officials, the additional flows would likely not have been enough to remove MDS administration in either year. Therefore, diversions of KBID return flows were limited to water rights senior to priority of the MDS.

Non-KBID farms would have used more irrigation water had it been available. Active irrigation surface water rights senior to MDS that were short in 2005 and 2006 were identified and are summarized in Appendix E-2. Water rights were limited to those

located between Spring Creek and Clay Center, KS, including rights on the mainstem and tributaries. The total average acre-feet used for the 1994 – 2004 period was calculated. The additional diversions were considered to be the differences between actual for each year and the average. Computed additional diversions that would have been used by senior irrigators from KBID return flows in 2005 and 2006 totaled approximately 2,500 acre-feet for the two-year period.

An additional set of senior surface water rights in Kansas were identified on the Republican River mainstem between the Stateline and the confluence with Spring Creek (Appendix E-4). Senior surface rights in this reach would have used additional water had it been available at Hardy. Water users in this section of the river would have had access to the additional water available at Hardy attributable to the Courtland Canal losses occurring above the Stateline in Nebraska. Computed additional diversions in this section totaled approximately 1,300 acre-feet for the two-year period.

The amount of additional return flow remaining undiverted would have been substantial. Milford Reservoir is located downstream of Clay Center and would have received additional inflows. The additional flow at Clay Center was estimated as the return flows minus the additional diversions of the non-KBID water rights. The amounts are 16,400 acre-feet in 2005 and 11,600 acre-feet in 2006. Table 4 is a summary of the derivation of the additional supply in Kansas from the overuse in Nebraska.

7.0 Summary

In summary, water users in Kansas would have received approximately 39,000 acre-ft on the KBID lands and diverted approximately 3,800 acre-feet to senior irrigators in 2005 and 2006 if the 78,960 acre-ft of overuse in Nebraska had been received at the Stateline. The analysis of additional water supply is summarized as followed:

Additional Water Supply in Kansas
(2005 – 2006)
(acre-feet/yr)

	2005	2006	Total
KBID	20,934	18,079	39,013
Downstream Senior Water Rights	1,727	2,104	3,831
Total	22,661	20,183	42,844

8.0 References

1. KBID Annual Reports
2. US Bureau of Reclamation spreadsheet data provided by KDWR for KBID water supply
3. US Bureau of Reclamation Annual Operating Plans
4. RRCA Annual Accounting Spreadsheets
5. USGS Real-Time Water Data for the Nation (http://waterdata.usgs.gov/nwis/rt)
6. Bureau of Reclamation HYDROMET database (http://www.usbr.gov/gp/hydromet/)
7. Kansas Water Information Management and Analysis System (WIMAS) (http://hercules.kgs.ku.edu/geohydro/wimas/index.cfm)
8. Nelson email (KBID), September 16, 2011, re: KBID drains
9. KDWR - MDS website (http://www.ksda.gov/appropriation/content/301)
10. US Bureau of Reclamation map of Courtland Unit Drains; 1977
11. Glover, R.E., 1974, Transient Ground Water Hydraulics: Water Resources Publications, P.O. Box 303, Fort Collins, CO 80522, pp. 89-137,141-144
12. IDS AWAS Alluvial Water Accounting System, Version 1.5.18, Schroeder Original
13. Technical Guidelines for determining the availability of groundwater for appropriation in the Lower Republican River Basin and Belleville Formation and the availability of surface water for appropriation in the Lower Republican River Basin
14. Fader, S.W., 1968, Ground water in the Republican River area, Cloud, Jewell, and Republic Counties, Kansas: Kansas Geological Survey Bulletin 188
15. Hansen, C.V., 1998, Water-Table Conditions, Aquifer Properties, and Streambed Permeability Along the Republican River from Near Hardy, Nebraska, to Concordia, Kansas: U.S. Geological Survey Water Resources Investigations Report 98-4162

ATTACHMENTS

Attachment 1

Nebraska's Violation of Water-Short Year Administration Requirement 2005 - 2006

Table 5C: Nebraska's Compliance During Water-Short Year Administration (from App. C of the FSS p. C65)*								
Year	Allocations			Computed Beneficial Consumptive Use (CBCU)			Credits from Imported Water	Difference Between Allocation and Consumptive Use Minus Imported Water Supply above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU Below Guide Rock	State Wide CBCU Above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
2005	199,450	4,586	194,864	253,740	4,052	249,688	11,965	(42,860)
2006	187,060	2,290	184,770	236,150	3,064	233,086	12,214	(36,100)
Average	193,260	3,440	189,820	244,950	3,560	241,390	12,090	(39,480)

*All average and total values are rounded to the nearest 10.

For 2005, two accountings were approved by the RRCA. The difference was caused by dispute over the inclusion or exclusion of evaporation from non-federal reservoirs in Nebraska below Harlan County Reservoir. The values displayed are from the accounting includes all non-federal reservoir evaporation in Nebraska, as proposed by Kansas.

For 2006, no accounting was approved by the RRCA. Only input data for the accounting was approved. The values displayed are consistent with the Kansas position on accounting inclusive of (1) all non-federal reservoir evaporation in Nebraska and (2) a Harlan County Reservoir evaporation assignment method that assigns evaporation to both Kansas and Nebraska when only one State takes water from Harlan County Storage.

Totals for 2005 and 2006 from table 5C

Year	Allocations			Computed Beneficial Consumptive Use (CBCU)			Credits from Imported Water	Difference Between Allocation and Consumptive Use Minus Imported Water Supply above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU Below Guide Rock	State Wide CBCU Above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
Totals	386,510	6,880	379,630	489,890	7,120	482,770	24,180	(78,960)

Note: Attachment 1 of the December 19, 2007 letter to Ann Bleed from David Barfield with revised 2006 values resulting from corrections made in the RRCA accounting spreadsheet.

Attachment 2

Nebraska's Five-Year Running Average Allocation and Computed Beneficial Consumptive Use for Determining Compact Compliance 2003 - 2007

Table 3C: Nebraska's Five-Year Average Allocation and CBCU (from App. C of the Fss p. 62)*				
	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive Use	Credits from Imported Water Supply Credit	Difference between Allocation and Computed Beneficial Consumptive Use minus Imported Water Supply
2003	227,580	262,780	9,782	(25,420)
2004	205,630	252,650	10,386	(36,630)
2005	199,450	253,740	11,965	(42,330)
2006	187,060	236,150	12,214	(36,880)
2007	244,380	242,830	21,933	23,480
Average	212,820	249,630	13,260	(23,560)

*All average and total values are rounded to the nearest 10.

The values for 2003 and 2004 were approved by the Republican River Compact Administration.

For 2005, two accountings were approved by the RRCA. The difference was caused by dispute over the inclusion or exclusion of evaporation from non-federal reservoirs in Nebraska below Harlan County Reservoir. The values displayed are from the accounting includes all non-federal reservoir evaporation in Nebraska, as proposed by Kansas.

For 2006, no accounting was approved by the RRCA. Only input data for the accounting was approved. The values displayed are consistent with the Kansas position on accounting inclusive of (1) all non-federal reservoir evaporation in Nebraska and (2) a Harlan County Reservoir evaporation assignment method that assigns evaporation to both Kansas and Nebraska when only one State takes water from Harlan County Storage.

For 2007, no accounting was approved by the RRCA. The values displayed are from an accounting consistent with the Kansas position on Harlan County Reservoir evaporation.

The totals of table 3C are below:

Year	Allocation	Computed Beneficial Consumptive Use	Credits from Imported Water Supply Credit	Difference between Allocation and Computed Beneficial Consumptive Use minus Imported Water Supply
Totals for 2003 to 2007	1,064,100	1,248,150	66,280	(117,780)

Note: Attachment 2 of the December 19, 2007 letter to Ann Bleed from David Barfield with revised 2006 values resulting from corrections made in the RRCA accounting spreadsheet.

Attachment 3

Nebraska's Violation of Water-Short Year Administration Requirement

2006 - 2007

Table 5C Nebraska's Compliance During Water-Short Year Administration (from App. C of the FSS p. C65)*								
Year	Allocations			Computed Beneficial Consumptive Use (CBCU)			Credits from Imported Water	Difference Between Allocation and Consumptive Use Minus Imported Water Supply above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU Below Guide Rock	State Wide CBCU Above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
2006	187,060	2,290	184,770	236,150	3,064	233,086	12,214	(36,100)
2007	244,380	16,311	228,069	242,830	2,770	240,060	21,939	9,950
Average	215,720	9,300	206,420	239,490	2,920	236,570	17,080	(13,080)

*All average and total values are rounded to the nearest 10.

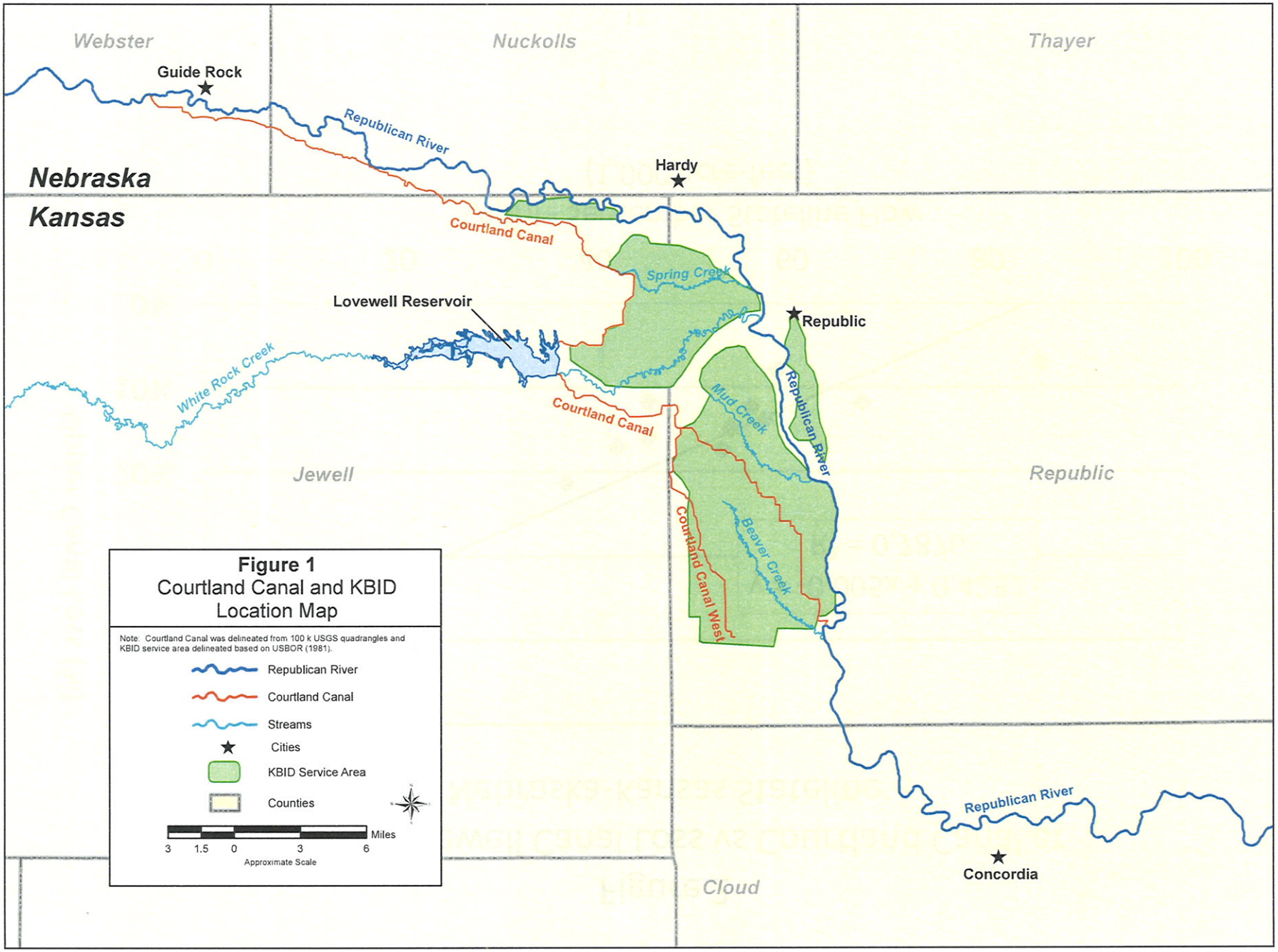
For 2006, no accounting was approved by the RRCA. Only input data for the accounting was approved. The values displayed are consistent with the Kansas position on accounting inclusive of (1) all non-federal reservoir evaporation in Nebraska and (2) a Harlan County Reservoir evaporation assignment method that assigns evaporation to both Kansas and Nebraska when only one State takes water from Harlan County Storage.

For 2007, no accounting was approved by the RRCA. The values displayed are from an accounting consistent with the Kansas position on Harlan County Reservoir evaporation.

Totals for 2006 and 2007 from table 5C

Year	Allocations			Computed Beneficial Consumptive Use (CBCU)			Credits from Imported Water	Difference Between Allocation and Consumptive Use Minus Imported Water Supply above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU Below Guide Rock	State Wide CBCU Above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
Totals	431,440	18,600	412,840	478,980	5,830	473,150	34,150	(26,150)

FIGURES


Webster
Nuckolls
Thayer
Guide Rock
Republican River
Hardy
Nebraska
Kansas
Courtland Canal
Spring Creek
Lovewell Reservoir
Republic
White Rock Creek
Courtland Canal
Mud Creek
Republican River
Jewell
Republic
Courtland Canal West
Beaver Creek
Republican River
Concordia
Cloud
Figure 1
Courtland Canal and KBID
Location Map
Note: Courtland Canal was delineated from 100 k USGS quadrangles and KBID service area delineated based on USBOR (1981).
Republican River
Courtland Canal
Streams
Cities
KBID Service Area
Counties
Miles
3 1.5 0 3 6
Approximate Scale

KS000373

Figure 2
Above Lovewell Canal Loss vs Courtland Canal at Nebraska-Kansas Stateline

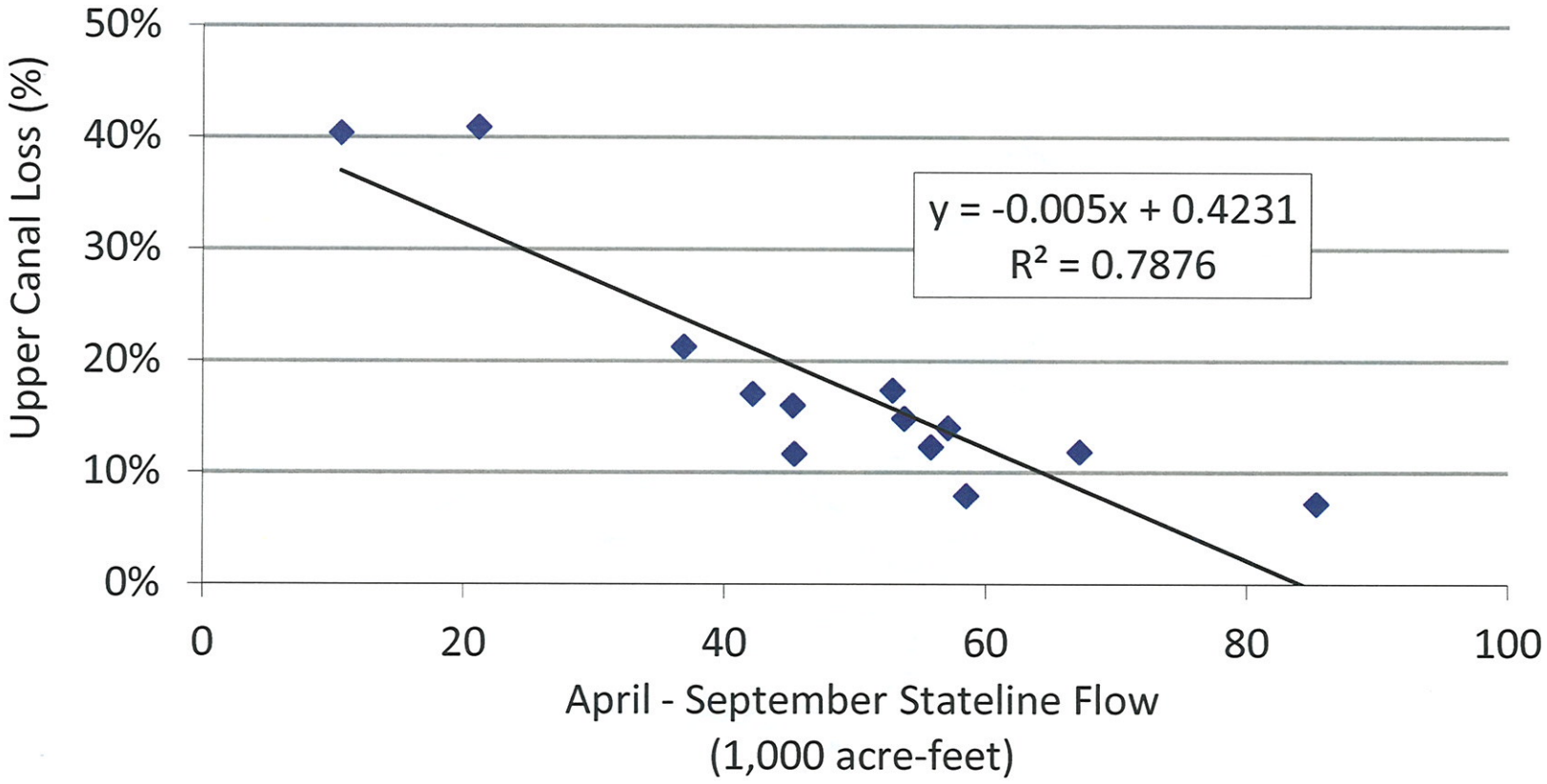


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Figure 3
Above Lovewell Lateral Losses vs Supply

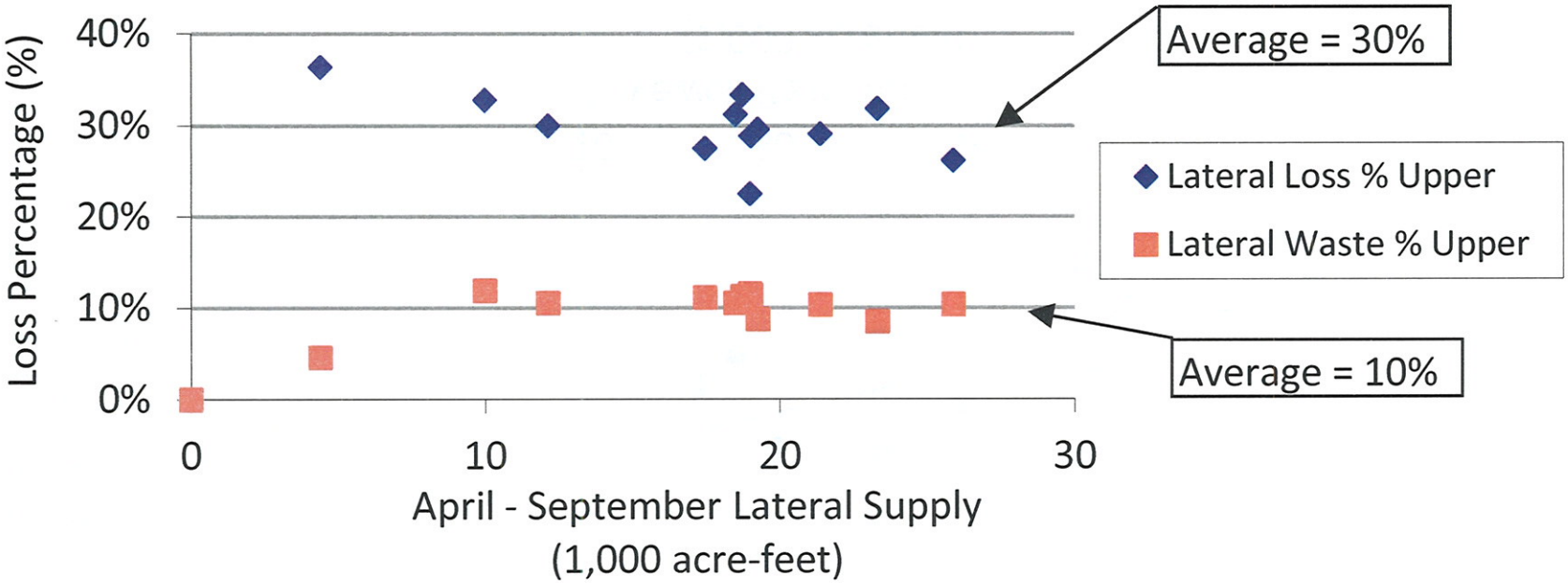

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Figure 4
Lovewell Reservoir Release vs Below Lovewell Canal Loss

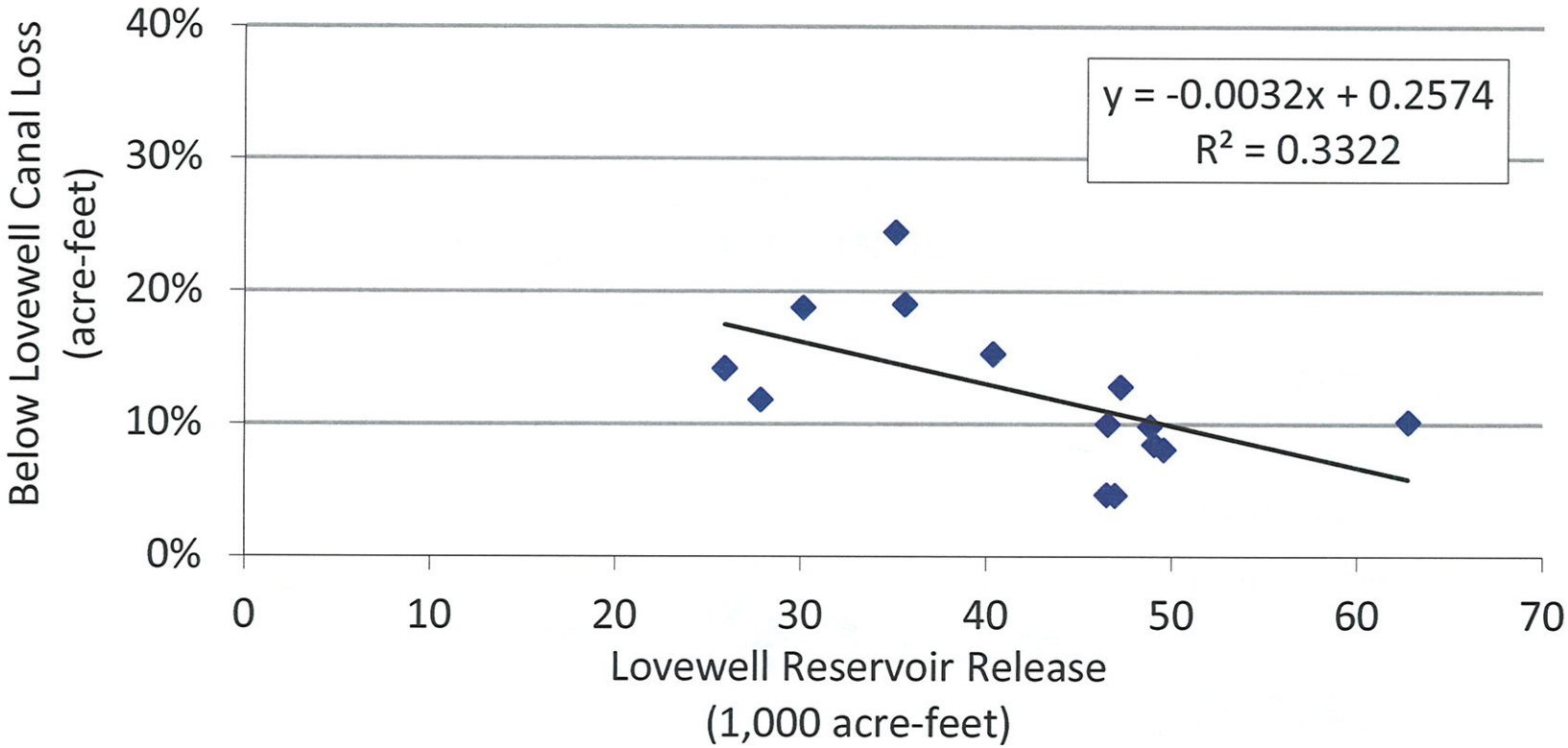

Figure 5
Below Lovewell Lateral Loss vs Supply

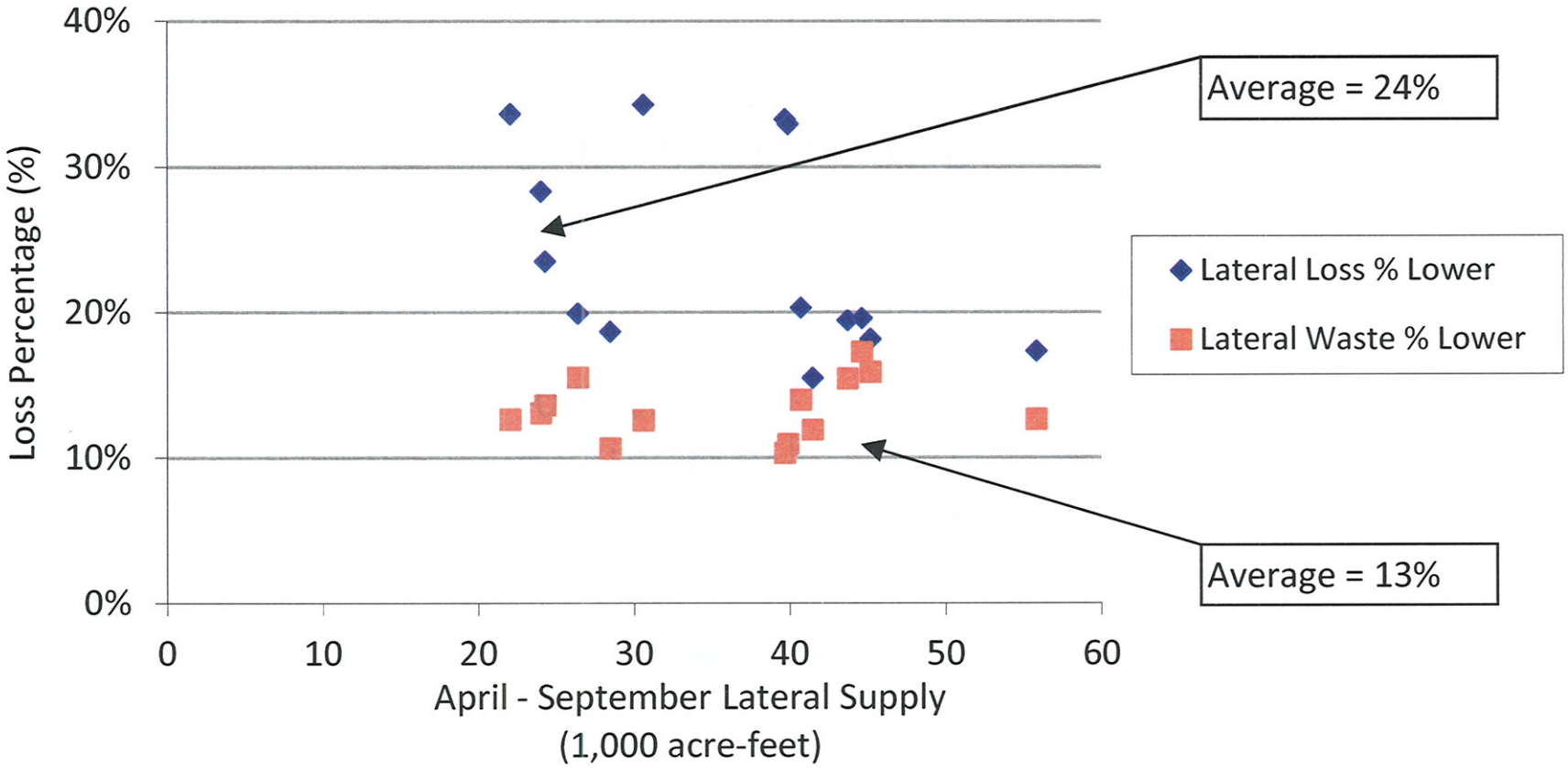

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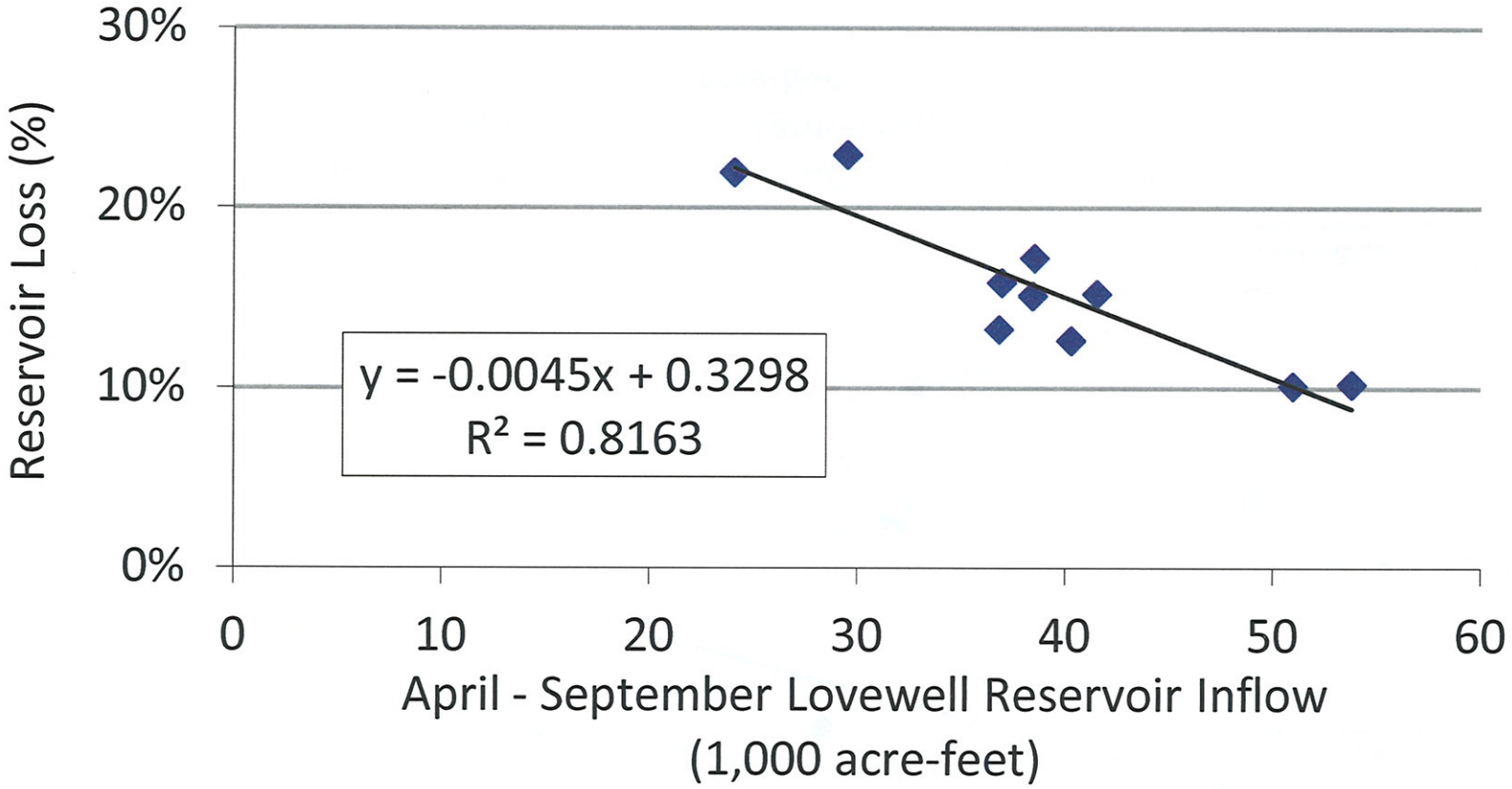
Figure 6
Reservoir Loss vs Lovewell Reservoir Inflow



KS000378

TABLES

Table 1
Summary of KBID Water Supply Analysis
2005 - 2006
(acre-feet)

		Historical		Adjusted		Additional	
	April - September Water Year	2005	2006	2005	2006	2005	2006
Above Lovewell (Apr-Sep WY)	Courtland Canal at Nebraska-Kansas Stateline	19,301	21,147	57,077	52,824	37,776	31,677
	Courtland Canal Loss Above Lovewell Reservoir	2,675	8,649	7,860	8,398	5,185	-252
	Courtland Canal Waste Above Lovewell Reservoir	0	0	0	0	0	0
	Courtland Canal Water Diverted by Upper Main Farm Headgate Delivery and Upper Laterals	561	5,154	49,217	44,427	48,656	39,273
	Upper Main Farm Headgate Delivery	561	759	1,199	1,289	638	530
	Upper Lateral Diversion	0	4,395	16,851	18,110	16,851	13,715
	Upper Lateral Waste	0	201	1,690	1,816	1,690	1,615
	Upper Lateral Loss	0	1,600	5,050	5,428	5,050	3,828
	Upper Lateral Farm Headgate Delivery	0	2,594	10,111	10,866	10,111	8,272
	Delivery to Lovewell Reservoir	16,065	7,344	31,167	25,027	15,102	17,683
Below Lovewell (Apr-Sep WY)	Release from Lovewell Reservoir	25,916	27,851	40,677	43,321	14,761	15,470
	Courtland Canal Loss Below Lovewell Reservoir	3,684	3,300	5,506	5,521	1,822	2,221
	Courtland Canal Waste Below Lovewell Reservoir	0	0	0	0	0	0
	Courtland Canal Water Diverted by Lower Main Farm Headgate Delivery and Lower Laterals	22,232	24,551	35,171	37,800	12,939	13,249
	Lower Main Farm Headgate Delivery	179	532	363	390	184	-142
	Lower Lateral Diversion	22,053	24,019	34,808	37,410	12,755	13,391
	Lower Lateral Waste	2,779	3,133	4,623	4,968	1,844	1,835
	Lower Lateral Loss	7,413	6,808	8,323	8,945	910	2,137
	Lower Lateral Farm Headgate Delivery	11,861	14,078	21,863	23,497	10,002	9,419
	Total Farm Delivery	12,601	17,963	33,535	36,042	20,934	18,079

Note: Waste is defined in USBR records as measured wasteway discharges.

Table 2

Summary of Lovewell Additional Water Supply

2005 - 2006

(acre-feet)

		Historical		Adjusted		Additional	
	April - September Water Year and Annual	2005	2006	2005	2006	2005	2006
Lovewell (Apr-Sep WY)	Courtland Canal Inflow	16,065	7,344	31,167	25,027	15,102	17,683
	Whiterock Creek Inflow	10,009	6,682	10,009	6,682	0	0
	Non-Courtland Canal Outflow	514	-132	514	-132	0	0
	Net Inflow	26,588	13,894	41,690	31,577	15,102	17,683
	Estimated Net Loss	-7,248	-7,022	-7,589	-9,236	-341	-2,214
	Release to Courtland Canal	25,916	27,851	40,677	43,321	14,761	15,470

Table 3
Summary of KBID Water Supply Analysis
Farm Deliveries and Acreages
2005 and 2006

		Actual [1]		Additional [2]		Adjusted [3]	
	Water Year	2005	2006	2005	2006	2005	2006
Above Lovewell	Total Delivery to Upper Farms (acre-feet)	561	3,353	**10,749**	**8,802**	11,310	12,155
	Upper Acreage (acres)	1,107	5,925			12,953	12,937
	Depth of Delivery (inches)	6.1	6.8			10.5	11.3
Below Lovewell	Total Delivery to Lower Farms (acre-feet)	12,040	14,610	**10,185**	**9,277**	22,225	23,887
	Lower Acreage (acres)	23,439	22,655			25,454	25,423
	Depth of Delivery (inches)	6.2	7.7			10.5	11.3
Total KBID	Total Delivery to Farms (acre-feet)	12,601	17,963	20,934	18,079	33,535	36,042
	Total Acreage (acres)	24,546	28,580			38,407	38,360
	Total Depth of Delivery (inches)	6.2	7.5			10.5	11.3

Notes:
(1) Actual - Data from USBR Annual Operating Plans.
(2) Additional Supply - Results from SWE's KBID Additional Flow Model.
(3) Total adjusted acreage that would have been irrigated provided by Joel Hamilton (Table 6, Kansas Damages).

Table 4

Derivation of Additional Supply in Kansas from Overuse in Nebraska
2005 - 2006
(acre-feet)

Description	2005	2006	Total
A. Allocation of Additional Supply			
Overuse in Nebraska	42,860	36,100	78,960
HCR Evaporation and Transportation Losses in NE	5,084	4,423	9,507
Net Available Stateline Supply	**37,776**	**31,677**	**69,453**
KBID Losses			
Canal	7,008	1,969	8,977
Lateral	9,493	9,415	18,908
Reservoir	341	2,214	2,555
KBID Farm Deliveries			
Above Lovewell	10,749	8,802	19,551
Below Lovewell	10,185	9,277	19,462
Total Farm Deliveries	**20,934**	**18,079**	**39,013**
B. Allocation of Return Flows			
(1) Return Flows from KBID	18,302	14,518	32,820
(2) Return Flow Losses	3,288	2,252	5,540
(3) Net Return Flows to Stream	15,014	12,266	27,280
(4) Downstream Diversions	1,233	1,269	2,502
(5) Total Additional Flow Available at Clay Center	13,781	10,997	24,778
(6) Courtland Canal Loss available at Hardy gage	3,069	1,399	4,468
(7) Diversions occurring between the Stateline and Spring Creek	494	835	1,329
(8) Additional Flow Available below Spring Creek	2,575	564	3,139
(9) **Total Additional Diversions**	**1,727**	**2,104**	**3,831**
(10) Total Remaining Additional Flow	16,356	11,561	27,917

Notes Regarding Allocation of Retun Flows:

(1) Sum of canal, lateral losses and estimated on-farm return flows, computed based on estimated irrigation efficiencies
(2) Applied an 18% evaporation loss on canal and lateral losses
(3) Net Return Flows to Stream = (1) - (2)
(4) Additional surface diversions of KBID return flows by irrigators senior to the minimum desirable streamflow
(5) Additional Flow Available at Clay Center (resulting from KBID Return Flows) = (3) - (4)
(6) Uncomsumed portion of the losses occurring from the additional supply in the Courtland Canal reach in Nebraska
(7) Additional surface diversions of Courtland Canal losses in Nebraska by irrigators senior to the minimum desirable
(8) Additional Flow Available below Spring Creek (resulting from Courtland Canal losses in Nebraska) = (6) - (7)
(9) Total Additional Diversions = (4) + (7)
(10) Total Remaining Additional Flow Available at Clay Center = (5) + (8)

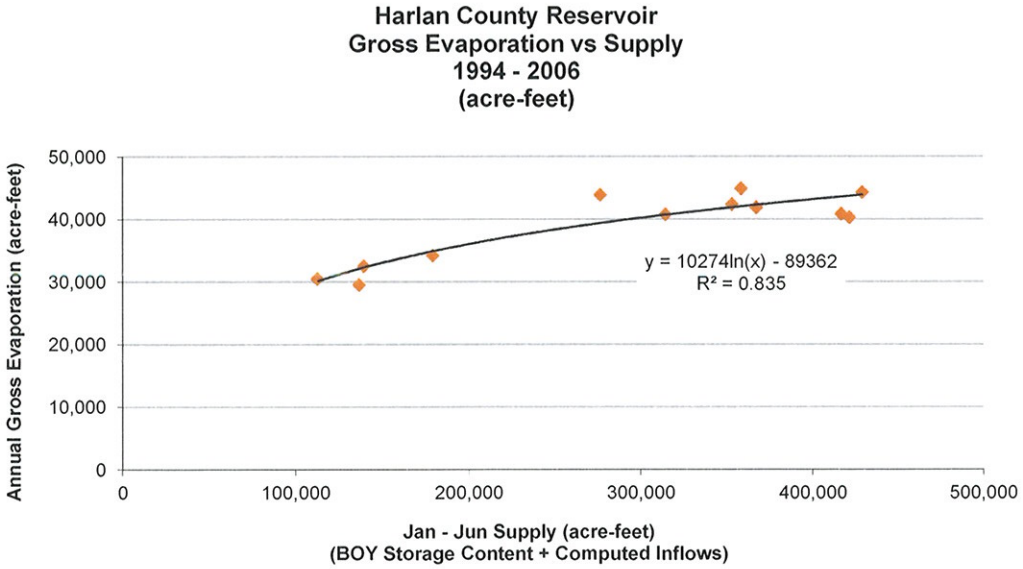
APPENDIX A

Harlan County Reservoir Historical Evaporation and Supply: 1994 - 2006

Appendix A
Harlan County Reservoir (HCR)
Historical Evaporation and Supply: 1994 - 2006

	Seasonal Summary				
Year	Annual Gross Evap acre-feet	Annual Net Evap acre-feet	Net Evap / Gross Evap %	Seasonal Supply (Jan-Jun) acre-feet	Gross Evap as a % of Supply %
1994	44,383	22,959	52%	429,012	10.3%
1995	40,356	14,953	37%	421,540	9.6%
1996					
1997	40,920	20,010	49%	416,669	9.8%
1998	41,929	16,666	40%	367,157	11.4%
1999	42,472	15,242	36%	352,906	12.0%
2000	45,006	20,422	45%	358,365	12.6%
2001	40,833	12,341	30%	314,505	13.0%
2002	43,988	29,526	67%	276,593	15.9%
2003	34,307	21,793	64%	179,391	19.1%
2004	30,601	17,013	56%	112,696	27.2%
2005	32,621	17,705	54%	139,441	23.4%
2006	29,609	16,298	55%	136,776	21.6%
Total	467,025	224,928	48%	3,505,051	13.3%

Source: Bureau of Reclamation HYDROMET database



Additional HCR Evaporation Analysis (acre-feet)

Year	Additional Supply	Adjusted Supply	Adjusted Gross Evap	Additional Net Evap	Adjusted Supply Less Net Evap
2005	42,860	182,301	35,091	1,341	**41,519**
2006	36,100	172,876	34,546	2,717	**33,383**

APPENDIX B

Courtland Canal Headgate Diversions, Stateline flows and Losses in Nebraska: 1995 - 2007

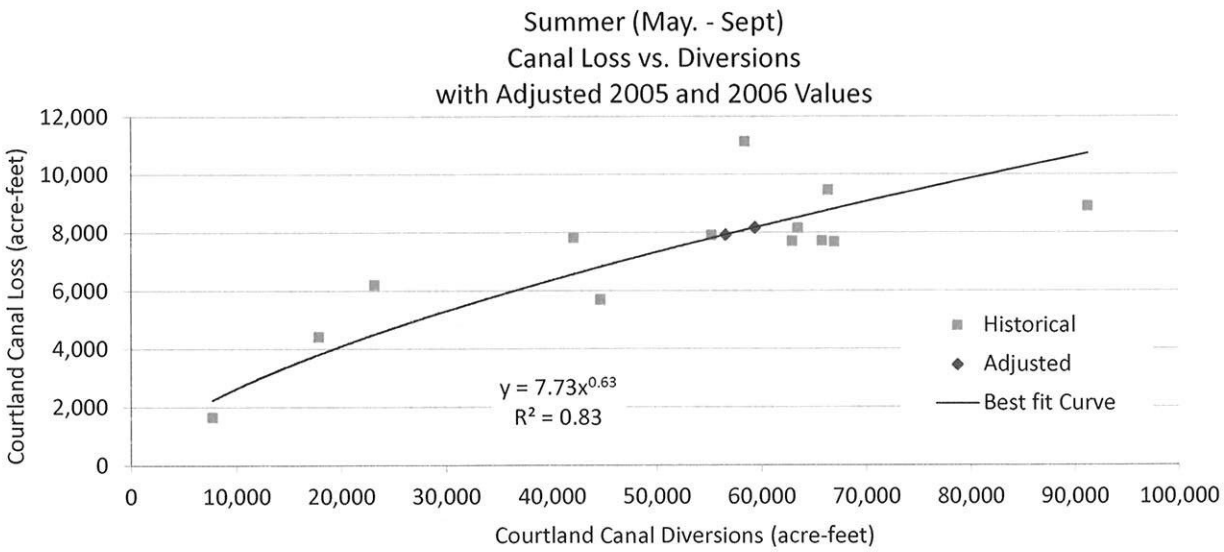
Appendix B-1

Courtland Canal

Summer Season Loss [1] vs. Diversions [2]

1994 - 2007 (May - Sept Totals)

acre-feet



Notes:

(1) Loss = diversions at Guide Rock (May - Sept) - NBID diversions (May - Sept) - Courtland Canal at Stateline Gage (May - Sept)

(2) Diversions = Courtland Canal diversions measured at the Stateline

Data Source: USGS Gage #06852500, Courtland Canal at Nebraska-Kansas Stateline and USBR provided BOST-MISC3MWD.XLS and NE-BOST3MWD.XLS

Appendix B-2

Courtland Canal
Summer Season Diversions, Stateline and Loss
1994 - 2007 (May - Sept Totals)
acre-feet

Year	(1) Diversions	(2) NBID	(3) Stateline	(4) Loss
1994	58,438	2,069	45,227	11,142
1995	66,943	2,159	57,099	7,685
1996		Removed		
1997	63,474	1,556	53,760	8,158
1998	65,785	2,381	55,680	7,724
1999	62,934	2,355	52,857	7,722
2000	91,247	3,463	78,872	8,912
2001	55,257	1,982	45,357	7,918
2002	66,376	2,263	54,632	9,481
2003	42,105	1,491	32,779	7,835
2004	7,702	0	6,035	1,667
2005	17,863	0	13,434	4,429
2006	23,202	0	16,982	6,220
2007	44,641	0	38,934	5,707
Average	51,228	1,517	42,434	7,277

Notes:

(1) Courtland Canal, Mile 0.7 (Guide Rock) as compiled by the USBR (BOST-MISC3MWD.XLS)
(2) Courtland Canal - Nebraska as compiled by the USBR (NE-BOST3MWD.XLS)
(3) USGS Gage #06852500, Courtland Canal at Nebraska-Kansas Stateline
(4) Loss = (1) - (2) - (3)

Appendix B-3

Courtland Canal Losses (Guide Rock to Stateline)

2005 and 2006 Historical and Adjusted

May - September

acre-feet

		Historical					Adjusted						
Year	Season	Guide Rock	NBID	Stateline	Loss	% Loss	Overuse at Guide Rock	Adjusted Diversions	Adjusted Loss	Additional Loss	Adjusted Stateline	Additional at Stateline	% Adjusted Loss
2005	Irrigation	17,863	0	13,434	4,429	25%	41,519	59,382	8,172	3,743	51,210	**37,776**	14%
2006	Irrigation	23,202	0	16,982	6,220	27%	33,383	56,585	7,926	1,706	48,659	**31,677**	14%
	Total	41,065	0	30,416	10,649	26%	74,902	115,967	16,098	5,449	99,869	**69,453**	14%

APPENDIX C

KBID Water Use Data

Appendix C-1

Courtland Canal at Stateline

acre-feet

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994				0	0	0	0	500	12,621	15,311	16,312	483	45,227
1995	9	0	0	3,977	2,300	0	0	0	2,666	20,466	21,761	12,206	63,386
1996	2,374	0	0	0	0	0	1,111	8,097	10,090	23,790	20,250	3,854	69,566
1997	0	0	0	0	0	0	0	3,636	8,372	21,128	15,787	4,837	53,760
1998	4,310	17	0	0	0	15	123	284	12,024	22,959	15,479	4,933	60,145
1999	0	0	0	0	0	0	0	378	9,019	21,973	14,097	7,391	52,857
2000	168	0	0	0	1,198	11,502	6,462	4,195	17,971	28,459	23,965	4,282	98,202
2001	3,802	4,665	4,612	4,633	762	0	0	0	5,576	15,999	14,946	8,836	63,831
2002	5,623	61	0	0	0	0	3,881	6,510	6,698	23,967	14,656	2,801	64,198
2003	3,834	4,788	4,364	3,898	2,512	0	4,110	5,645	4,171	12,074	8,410	2,479	56,284
2004	2,128	2,926	3,320	3,640	1,914	1,515	4,552	3,078	1,004	1,728	39	185	26,031
2005	1,525	2,156	2,537	1,987	4,233	4,665	5,867	4,261	5,359	770	1,900	1,144	36,405
2006	1,644	2,206	2,220	3,134	2,694	3,767	4,413	2,630	3,431	8,181	1,134	1,359	36,811
2007	1,795	2,634	2,912	2,727	2,918	4,261	4,709	5,643	4,473	12,256	10,977	4,104	59,408
Average	2,093	1,496	1,536	1,714	1,324	1,838	2,516	3,204	7,391	16,361	12,837	4,207	56,151

Source: USGS Gage #06852500, Courtland Canal at Nebraska-Kansas Stateline

Appendix C-2

Above Lovewell Reservoir Farm Delivery

acre-feet

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994				0	0	0	0	0	2,490	2,768	6,172	37	11,467
1995	0	0	0	0	0	0	0	0	13	8,250	6,073	1,085	15,421
1996	0	0	0	0	0	0	0	0	3,331	5,870	4,517	214	13,932
1997	0	0	0	0	0	0	0	0	422	7,841	3,402	222	11,887
1998	0	0	0	0	0	0	0	0	2,211	5,827	4,475	204	12,717
1999	0	0	0	0	0	0	0	0	1,017	9,301	3,653	429	14,400
2000	0	0	0	0	0	0	0	124	4,626	7,475	6,048	70	18,343
2001	0	0	0	0	0	0	0	0	1,277	3,340	6,635	742	11,994
2002	0	0	0	0	0	0	0	0	1,854	7,944	3,588	0	13,386
2003	0	0	0	0	0	0	0	0	0	5,363	3,012	0	8,375
2004	0	0	0	0	0	0	0	0	0	43	11	0	54
2005	0	90	0	0	0	0	0	0	373	125	63	0	651
2006	0	0	0	0	0	0	0	15	274	2,765	258	41	3,353
2007	0	0	0	0	0	0	0	0	66	3,266	2,457	0	5,789
Average	0	7	0	0	0	0	0	10	1,282	5,013	3,597	217	10,126

Source: US Bureau of Reclamation

Appendix C-3

Inflow to Lovewell Reservoir

acre-feet

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994				0	0	0	0	0	3,536	7,657	6,369	607	18,169
1995	0	0	0	3,490	2,060	0	0	0	837	3,813	10,199	9,450	29,849
1996	1,990	0	0	0	0	0	105	4,875	2,207	14,724	13,192	3,746	40,839
1997	0	0	0	0	0	0	0	2,476	4,180	7,180	8,609	3,731	26,176
1998	3,626	0	0	0	0	0	0	0	4,742	12,075	7,876	3,877	32,196
1999	0	0	0	0	0	0	0	0	2,888	7,234	6,614	4,115	20,851
2000	0	0	0	0	835	10,025	6,825	1,838	7,668	16,875	14,631	3,563	62,260
2001	3,130	4,092	3,997	4,027	764	0	0	0	1,324	8,933	4,356	6,713	37,336
2002	4,792	0	0	0	0	0	3,043	5,470	1,686	11,412	9,023	2,488	37,914
2003	3,572	3,878	3,581	3,355	1,740	0	3,167	4,232	1,426	2,061	3,288	1,582	31,882
2004	1,189	2,006	2,550	2,685	1,398	1,128	3,776	2,150	104	230	0	0	17,216
2005	0	831	1,828	1,804	3,430	3,950	5,677	3,749	4,164	0	1,562	913	27,908
2006	884	1,512	1,620	2,473	1,968	2,862	3,509	1,004	478	1,863	91	399	18,663
2007	873	1,611	1,964	2,047	4,076	3,602	3,941	4,447	1,806	5,318	5,975	3,227	38,887
Average	1,543	1,072	1,195	1,420	1,162	1,541	2,146	2,160	2,646	7,098	6,556	3,172	31,439

Source: US Bureau of Reclamation Annual Operating Plans

Appendix C-4

Releases from Lovewell Reservoir

acre-feet

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994				0	0	0	0	1,254	7,744	11,560	19,706	97	40,361
1995	0	0	0	0	0	0	0	484	2,176	18,839	19,603	5,391	46,493
1996	0	0	0	0	0	0	0	424	13,049	17,219	14,737	1,517	46,946
1997	0	0	0	0	0	0	0	607	6,514	24,679	15,204	1,827	48,831
1998	0	0	0	0	0	0	0	369	12,347	19,286	14,912	2,144	49,058
1999	0	0	0	0	0	0	0	246	5,461	26,946	13,831	3,086	49,570
2000	0	0	0	0	0	0	0	2,033	15,007	24,088	21,327	290	62,745
2001	0	0	0	0	0	0	0	0	6,748	16,166	20,619	3,711	47,244
2002	0	0	0	0	0	0	0	0	9,697	24,676	12,184	0	46,557
2003	0	0	0	0	0	0	0	472	3,647	19,015	12,472	0	35,606
2004	0	0	0	0	0	0	0	982	1,417	9,713	18,022	0	30,134
2005	0	0	0	0	0	0	0	0	4,310	14,572	7,034	0	25,916
2006	0	0	0	0	0	0	0	492	4,796	13,730	8,833	0	27,851
2007	0	0	0	0	0	0	0	1,895	4,637	15,064	13,505	0	35,101
Average	0	0	0	0	0	0	0	661	6,968	18,254	15,142	1,290	42,315

Source: US Bureau of Reclamation

Appendix C-5

Below Lovewell Reservoir Farm Delivery

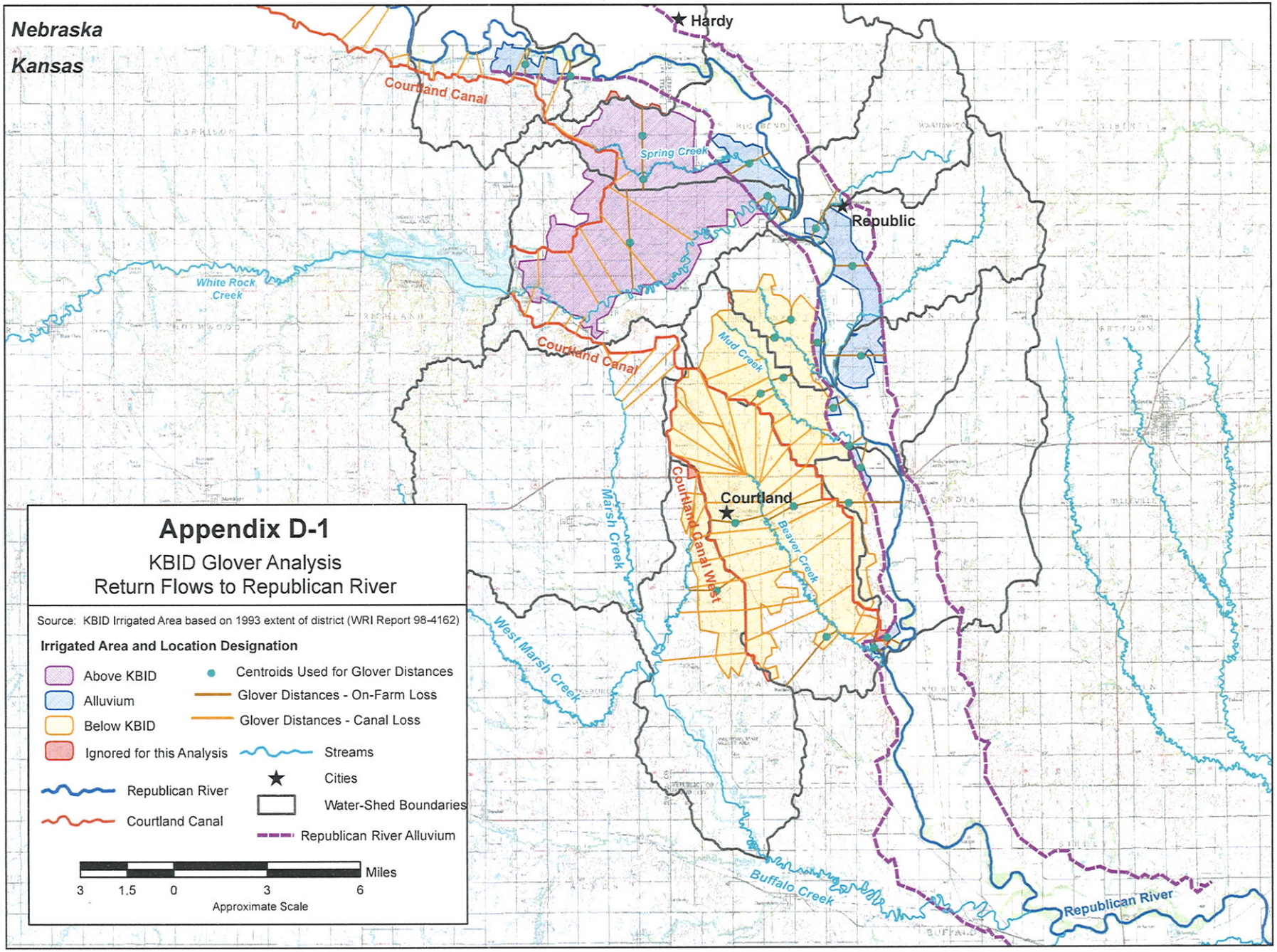
acre-feet

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1994				0	0	0	0	0	1,928	4,978	12,842	115	19,863
1995	0	0	0	0	0	0	0	0	11	11,613	12,454	2,975	27,053
1996	0	0	0	0	0	0	0	0	7,793	10,725	8,252	547	27,317
1997	0	0	0	0	0	0	0	0	1,659	17,580	8,802	777	28,818
1998	0	0	0	0	0	0	0	0	6,715	12,267	8,609	884	28,475
1999	0	0	0	0	0	0	0	0	1,162	19,708	7,757	1,586	30,213
2000	0	0	0	0	0	0	0	285	9,122	16,891	13,212	163	39,673
2001	0	0	0	0	0	0	0	0	2,676	8,920	13,661	1,983	27,240
2002	0	0	0	0	0	0	0	0	4,529	18,064	7,973	0	30,566
2003	0	0	0	0	0	0	0	0	0	12,118	8,372	0	20,490
2004	0	0	0	0	0	0	0	0	0	4,043	11,413	0	15,456
2005	0	0	0	0	0	0	0	0	1,394	7,353	3,293	0	12,040
2006	0	0	0	0	0	0	0	0	1,601	7,310	5,699	0	14,610
2007	0	0	0	0	0	0	0	0	196	8,735	8,233	0	17,164
Average	0	0	0	0	0	0	0	20	2,770	11,450	9,327	645	24,213

Source: US Bureau of Reclamation

APPENDIX D

Summary of KBID Return Flow Timing Analysis: Inputs and Results


Nebraska
Kansas
Hardy
Republic
Courtland
Courtland Canal
Spring Creek
White Rock Creek
Mud Creek
Courtland Canal West
Marsh Creek
Beaver Creek
West Marsh Creek
Buffalo Creek
Republican River
Appendix D-1
KBID Glover Analysis
Return Flows to Republican River
Source: KBID Irrigated Area based on 1993 extent of district (WRI Report 98-4162)
Irrigated Area and Location Designation
Above KBID
Alluvium
Below KBID
Ignored for this Analysis
Republican River
Courtland Canal
Centroids Used for Glover Distances
Glover Distances - On-Farm Loss
Glover Distances - Canal Loss
Streams
Cities
Water-Shed Boundaries
Republican River Alluvium
Miles
3 1.5 0 3 6
Approximate Scale

KS000395

Appendix D-2

Pumping Test Data in the Republican River area, Kansas

County	Well Number Report	Location						Geologic Source	Transmissivity (gpd/ft)	Type of Test
		Township	Range	Section	1/4 Section	1/4, 1/4 Section	1/4, 1/4, 1/4 Section			
Republic	1-3W-3bc	1	3W	3	NW	SW		Qd	320,000	SC
	1-3W-5aa	1	3W	5	NE	NE		Qd	190,000	SC
	1-4W-17ab	1	4W	17	NE	NW		Qd	288,000	SC
	1-5W-15ab	1	5W	15	NE	NW		Qd	50,000	SC
	2-4W-31bc	2	4W	31	NW	SW		Qd	60,000	SC
	3-4W-8ccb	3	4W	8	SW	SW	NW	Qa	100,000	OW
	3-4W-17bd	3	4W	17	NW	SE		Qa	72,000	SC
	3-4W-17db	3	4W	17	SE	NW		Qa	45,000	SC
	3-4W-20aa	3	4W	20	NE	NE		Qa	60,000	SC
	3-4W-32da	3	4W	32	SE	NE		Qa	110,000	SC
	4-4W-4bc	4	4W	4	NW	SW		Qa	50,000	SC
	4-4W-4db	4	4W	4	SE	NW		Qw	175,000	SDD
	4-4W-4dc	4	4W	4	SE	SW		Qw	130,000	OW
	4-4W-8ad	4	4W	4	NE	SE		Qa	75,000	SC
	4-4W-8bd	4	4W	4	NW	SE		Qa	65,000	SC
	4-4W-8dd	4	4W	4	SE	SE		Qa	75,000	SC
	4-4W-9ab	4	4W	9	NE	NW		Qw	125,000	SC
	4-4W-9ca	4	4W	9	SW	NE		Qa	150,000	SC
	4-4W-15cd	4	4W	15	SW	SE		Qi	10,000	SC
	4-4W-17da	4	4W	17	SE	NE		Qa	200,000	SC
	4-4W-17dd	4	4W	17	SE	SE		Qa	90,000	SC
	4-4W-21caa	4	4W	21	SW	NE	NE	Qw	170,000	SDD
	4-4W-21cab	4	4W	21	SW	NE	NW	Qw	120,000	SDD
	4-4W-22ca	4	4W	22	SW	NE		Qi	60,000	SC
	4-4W-22cc	4	4W	22	SW	SW		Qi	95,000	SC
	4-4W-27ddc	4	4W	27	SE	SE	SW	Qw	70,000	SDD
	4-4W-29db	4	4W	29	SE	NW		Qa	80,000	SC
	4-4W-33aa	4	4W	33	NE	NE		Qw	140,000	SC
	4-4W-34baa	4	4W	34	NW	NE	NE	Qw	120,000	SC

Source: Fader (1968)

Summary of Transmissivity

		T (gpd/ft)
Alluvium Median:	K.A.R. 5-3-11	**100,000**
Upland Loess Deposits Range of T:	Qi	10,000
	Qi	60,000
	Average	**35,000**

***Values in yellow applied in SWE analysis**

Appendix D-3
Glover Inputs (Alluvial Aquifer Method)
On-Farm Losses
Kansas Bostwick Irrigation District

Location	(1) T (gpd/ft)	(2) Sy	(3) X (ft)	(4) W (ft)
Above KBID	43,700	0.2	6,338	12,923
Below KBID	42,400	0.2	4,125	7,794

Notes:

(1) Weighted transmissivity calculated from pump tests (Fader, 1968 and K.A.R. 5-3-11.)
(2) Estimated specific yield
(3) Average length from point of return to stream calculated in GIS
(4) Average length to boundary calculated in GIS

Appendix D-4
Glover Inputs (Alluvial Aquifer Method)
Canal Losses
Kansas Bostwick Irrigation District

Location	(1) T (gpd/ft)	(2) Sy	(3) X (ft)	(4) W (ft)
Above KBID	43,700	0.2	6,154	12,923
Below KBID	42,400	0.2	9,197	9,197

Notes:

(1) Weighted transmissivity calculated from pump tests (Fader, 1968 and K.A.R. 5-3-11.)
(2) Estimated specific yield
(3) Average length from main canal to stream calculated in GIS
(4) Average length to boundary calculated in GIS

Appendix D-5
Glover Inputs (Parallel Drain Method)
Kansas Bostwick Irrigation District

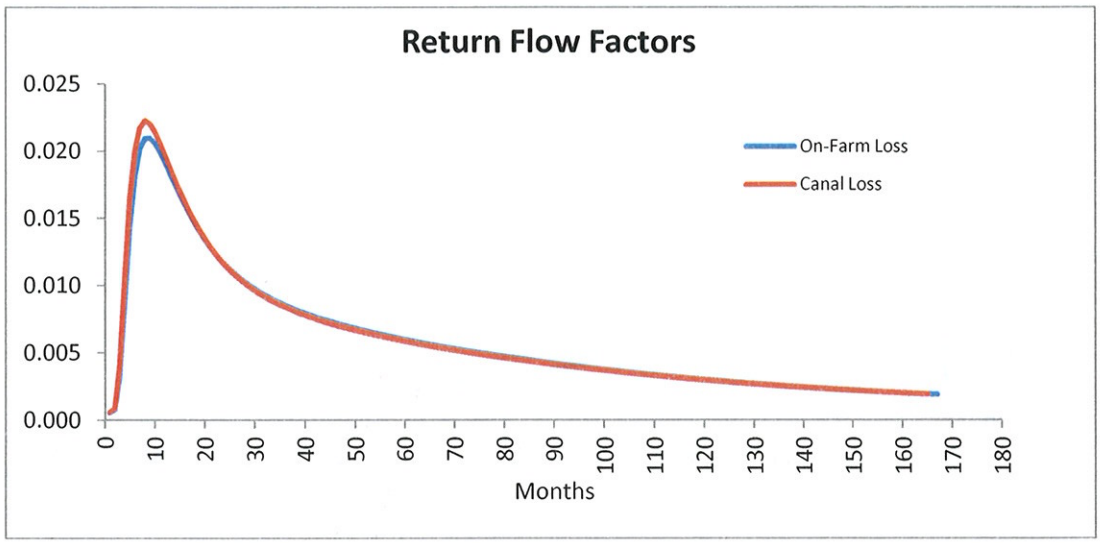
Location	(1) T (gpd/ft)	(2) Sy	(3) Area (ft^2)	(4) Drain Length (ft)	(5) Avg Drain Spacing (ft)	(6) X (ft)
Above KBID	43,700	0.2	624,454,216	532,893	1,172	590
Below KBID	42,400	0.2	1,231,705,836	1,051,107	1,172	590

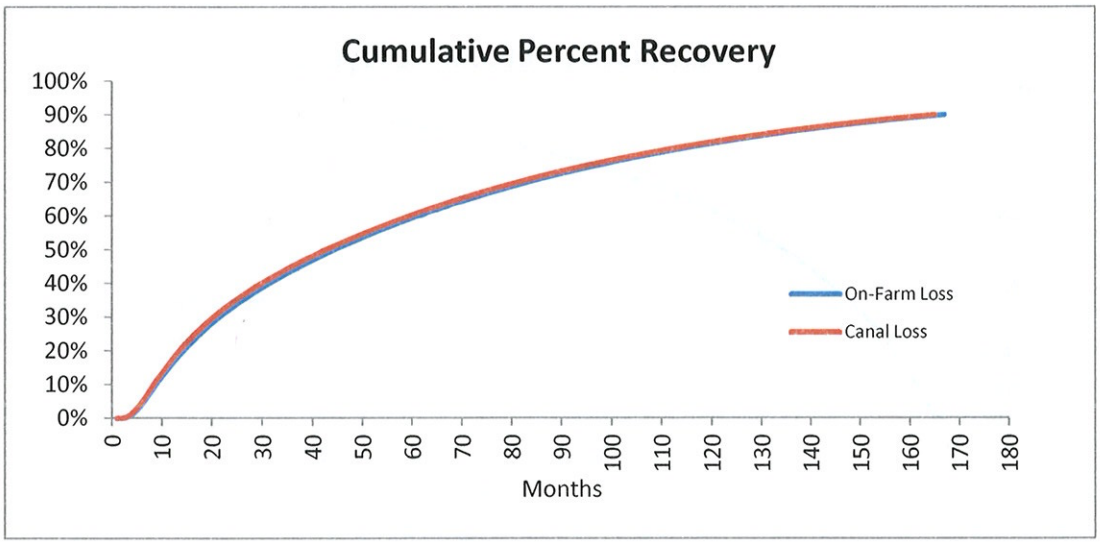
Source: Transient Ground Water Hydraulics, Robert E. Glover, Chapter 8

Notes:

(1) Weighted transmissivity calculated from pump tests (Fader, 1968 and K.A.R. 5-3-11.)
(2) Estimated specific yield
(3) Area of KBID based on 1994 - 2000 average (KBID Annual Reports)
(4) Estimated total lenth of drains within the KBID service area - assuming 300 miles of drains (reference email from Kenny Nelson, 9/16/2011)
(5) Calculated as (3) / (4)
(6) Midway between drains, Calculated as (3) / 2, rounded to the nearest tenth

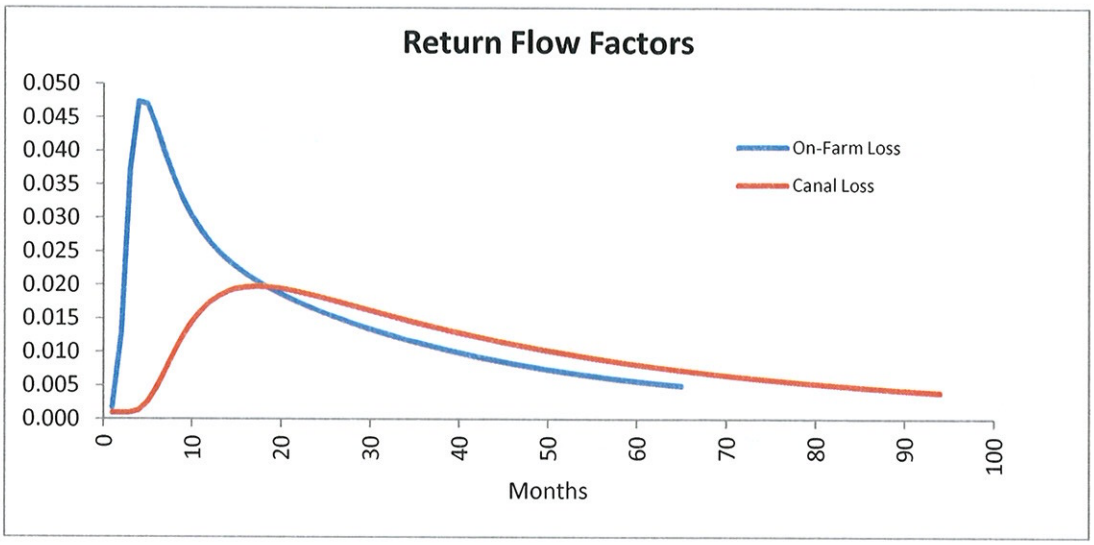
Appendix D-6
Glover Results (Alluvial Aquifer Method)
Above KBID

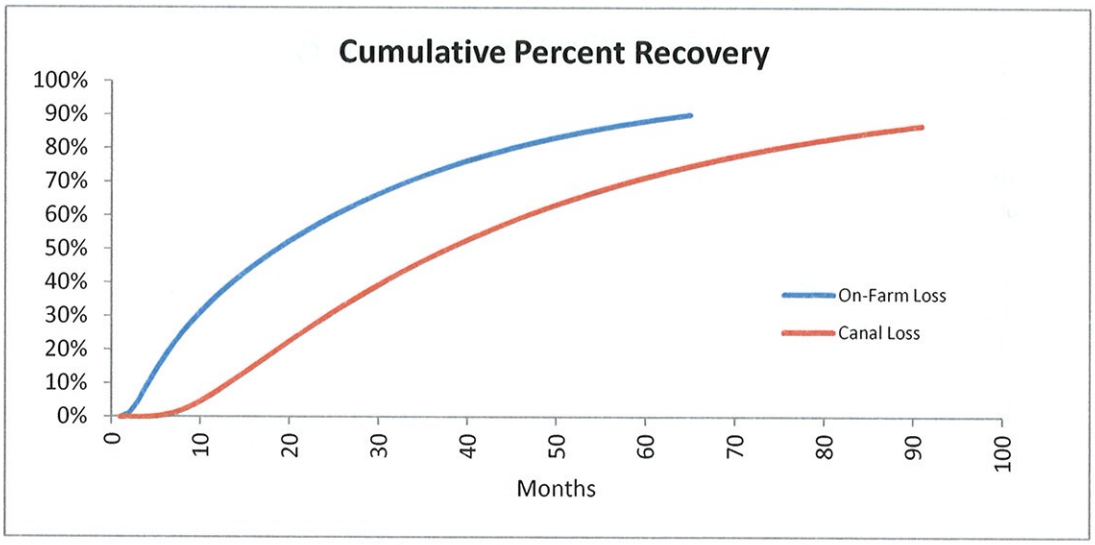




Note:
The factors were calculated until 90% percent returns to the river. The remaining 10% percent was distributed evenly among the factors.

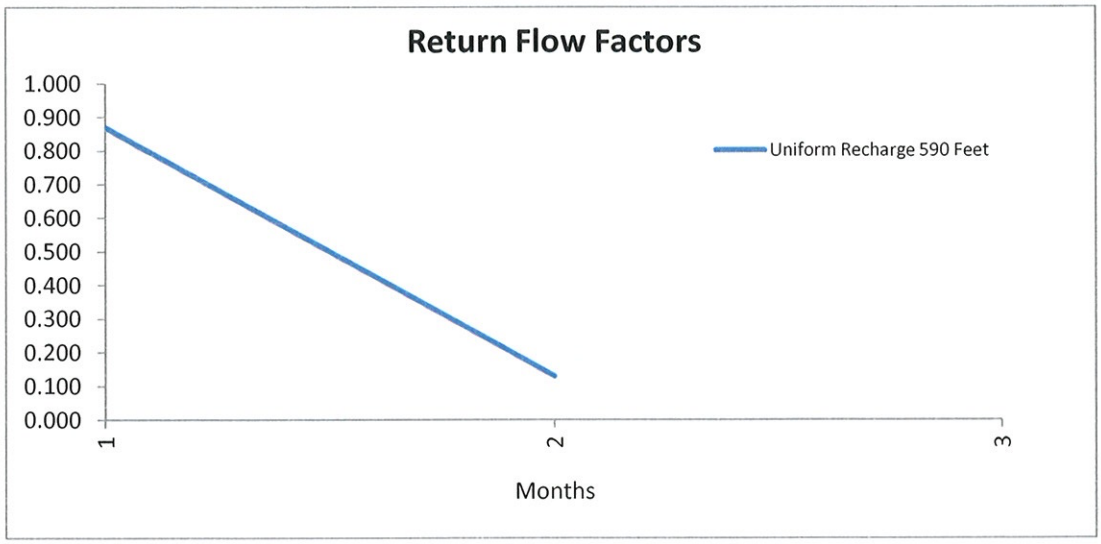
Appendix D-7
Glover Results (Alluvial Aquifer Method)
Below KBID

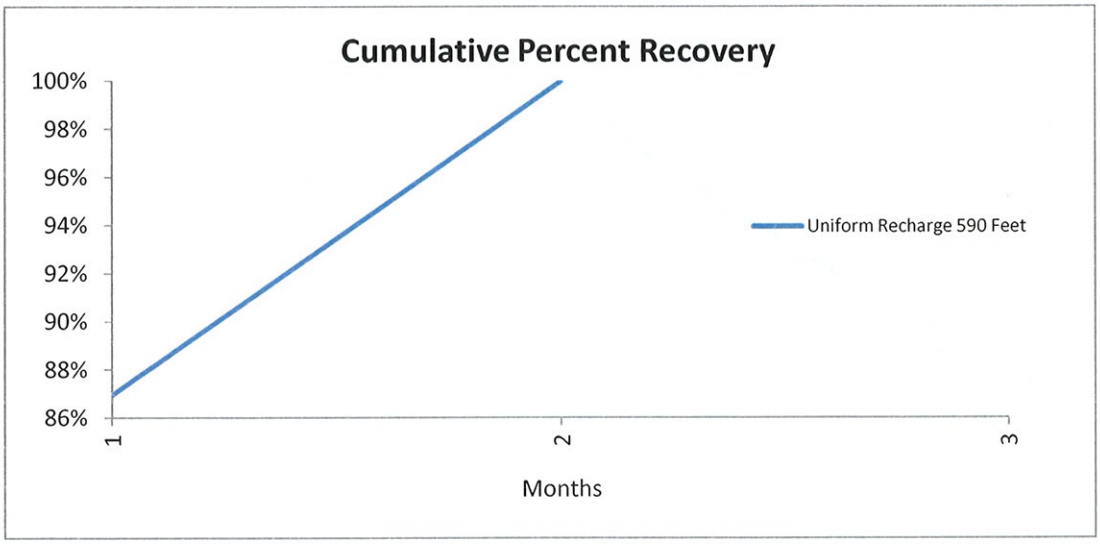




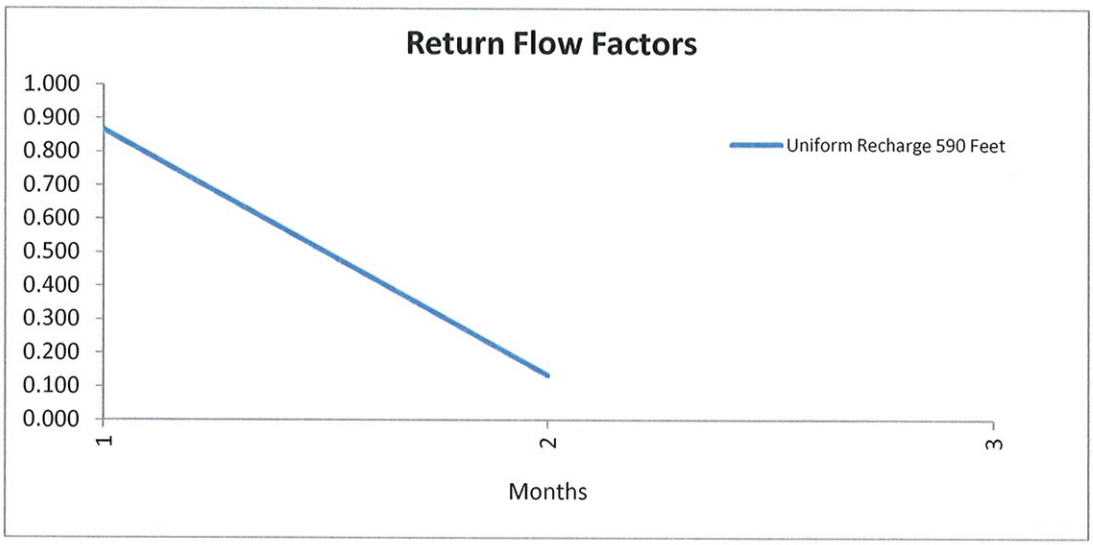
Note:
The factors were calculated until 90% percent returns to the river. The remaining 10% percent was distributed evenly among the factors.

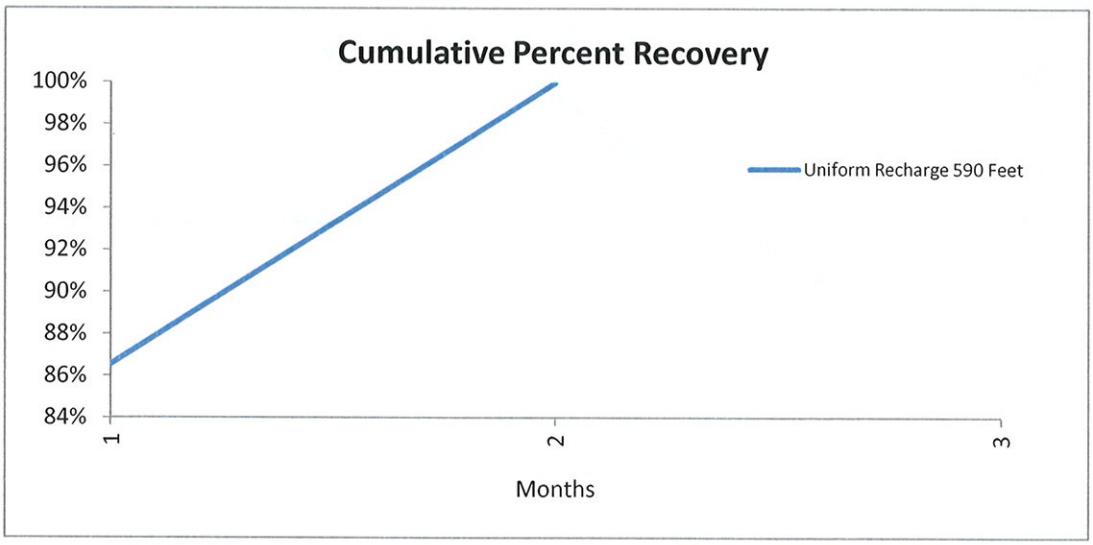
Appendix D-8
Glover Results (Parallel Drains)
Above KBID





Appendix D-9
Glover Results (Parallel Drains)
Below KBID





Appendix D-10

Kansas Bostwick Irrigation District
Combined Above and Below Lovewell
Total Lagged Returns (acre-ft)

% of KBID Drained **75%**

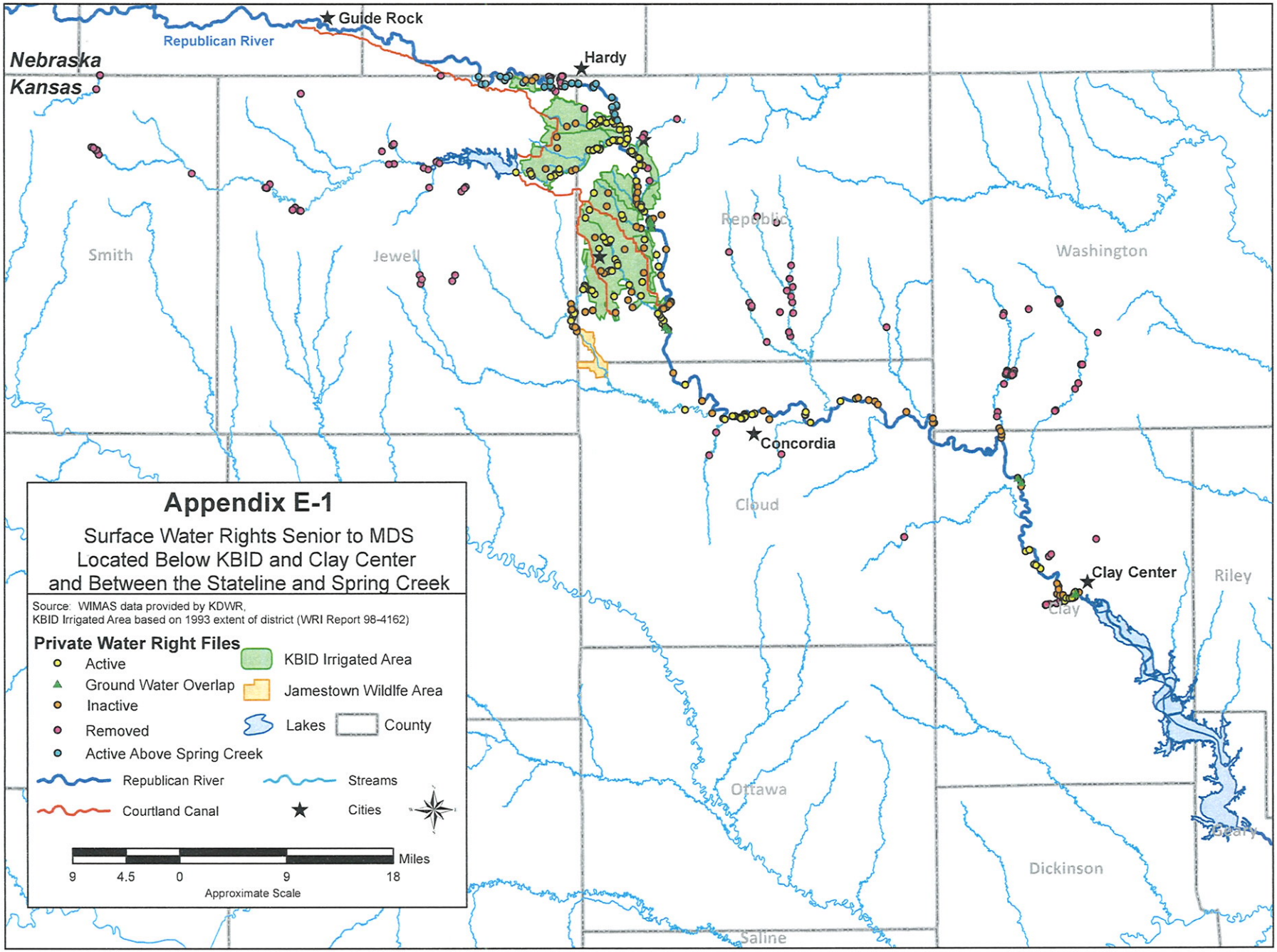
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Irr Season
2005	-	-	-	-	32	1,843	6,042	5,906	952	89	69	80	15,013	14,775
2006	85	86	85	83	105	1,482	4,664	4,528	760	141	123	124	12,266	11,540
2007	123	120	116	113	109	106	102	99	96	93	90	87	1,252	511
Avg	69	69	67	65	82	1,144	3,603	3,511	602	108	94	97	9,511	8,942
Max	123	120	116	113	109	1,843	6,042	5,906	952	141	123	124	15,013	14,775
Min	-	-	-	-	32	106	102	99	96	89	69	80	1,252	511

Note: Irrigation Season is May - September

2005 Irrigation Season Rate (cfs) 49
2006 Irrigation Season Rate (cfs) 38

APPENDIX E

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS)


Guide Rock
Republican River
Nebraska
Kansas
Hardy
Smith
Jewell
Republic
Washington
Concordia
Cloud
Clay Center
Riley
Clay
Ottawa
Dickinson
Saline
Appendix E-1
Surface Water Rights Senior to MDS
Located Below KBID and Clay Center
and Between the Stateline and Spring Creek
Source: WIMAS data provided by KDWR,
KBID Irrigated Area based on 1993 extent of district (WRI Report 98-4162)
Private Water Right Files
Active
Ground Water Overlap
Inactive
Removed
Active Above Spring Creek
KBID Irrigated Area
Jamestown Wildlfe Area
Lakes
County
Republican River
Courtland Canal
Streams
Cities
Miles
9
4.5
0
9
18
Approximate Scale

KS000405

Appendix E-2

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS)

ac-ft used

Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Max 1994 - 2004	Averages 1994 - 2004	Averages 2005 - 2006	Averages 2007 - 2010
103	-	25.0	21.8	-	31.1	26.2	28.9	27.3	24.3	23.8	24.1	-	-	14.3	-	-	-	31.1	21.1	-	3.6
483	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
493	60.6	70.9	76.9	83.9	88.3	85.3	94.6	88.5	111.8	105.1	57.1	54.8	90.4	72.7	58.8	42.5	75.6	111.8	83.9	72.6	62.4
931	73.7	88.4	97.2	132.6	132.6	132.6	103.1	88.4	103.1	48.7	61.9	22.9	22.4	20.8	14.3	25.3	51.1	132.6	96.6	22.6	27.9
951	-	-	-	-	-	-	-	-	-	3.8	-	-	-	-	-	-	-	3.8	0.3	-	-
1203	-	-	-	-	-	126.8	-	-	-	-	-	-	-	-	-	-	-	126.8	11.5	-	-
2333	-	-	41.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41.8	3.8	-	-
2510	20.1	23.0	18.2	24.9	6.9	3.7	5.5	-	-	-	-	-	-	-	-	-	-	24.9	9.3	-	-
2540	-	-	30.1	32.7	39.1	30.9	31.8	34.9	28.7	-	-	-	-	-	3.0	-	-	39.1	20.8	-	0.8
2645	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3786	9.7	45.6	65.6	51.0	24.3	43.8	97.2	48.6	34.0	8.0	18.5	2.4	19.6	-	-	-	-	97.2	40.6	11.0	-
3897	100.6	202.7	88.4	125.7	19.0	41.3	224.1	47.0	132.6	38.0	39.8	23.8	11.6	-	-	32.2	8.8	224.1	96.3	17.7	10.2
3993	-	27.8	-	52.1	-	-	73.4	70.3	90.4	-	27.8	29.2	37.2	36.9	26.5	31.8	28.0	90.4	31.1	33.2	30.8
4575	-	-	77.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77.2	7.0	-	-
4741	56.7	41.6	38.1	35.5	32.6	39.0	38.4	35.5	45.6	35.9	34.5	-	-	17.0	9.0	26.5	18.7	56.7	39.4	-	17.8
4925	19.3	26.8	26.9	78.1	90.6	53.9	82.5	61.5	141.7	88.0	44.0	89.0	58.0	87.0	69.0	41.0	62.0	141.7	64.9	73.5	64.8
5069	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6161	-	2.8	-	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	2.8	0.3	-	-
6216	8.7	5.3	5.0	-	-	4.6	11.2	-	-	-	-	-	-	-	-	-	1.8	11.2	3.2	-	0.5
6268	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6592	71.4	124.6	84.5	80.2	-	-	-	-	-	-	-	-	-	-	-	-	-	124.6	32.8	-	-
6606	11.8	27.1	8.8	23.6	10.6	35.4	18.4	16.9	22.8	-	24.6	6.3	2.3	4.9	-	-	-	35.4	18.2	4.3	1.2
7313	-	2.7	-	-	-	-	-	-	-	-	12.2	-	-	-	-	-	-	12.2	1.3	-	-
8357	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8637	39.2	75.0	61.6	42.4	58.0	63.4	63.3	56.9	65.4	47.0	56.0	34.0	34.0	-	58.0	53.0	70.0	75.0	57.1	34.0	45.3
9191	2.7	51.3	30.9	50.2	31.0	31.0	28.8	31.0	22.1	35.1	15.6	9.5	-	-	13.2	11.9	15.9	51.3	30.0	4.7	10.3
9964	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10073	11.9	-	21.2	28.3	21.2	24.7	28.3	23.3	31.8	24.3	29.5	46.9	-	-	-	-	-	31.8	22.2	23.5	-
10082	58.4	101.7	66.1	45.3	56.9	59.2	99.6	76.4	87.1	58.6	46.5	60.4	86.4	73.2	49.3	71.3	55.8	101.7	68.7	73.4	62.4
10675	61.7	160.8	20.5	32.3	81.7	44.1	92.2	73.6	85.4	13.3	0.9	70.8	67.6	27.3	34.9	53.6	54.6	160.8	60.6	69.2	42.6
11192	4.2	5.9	5.1	5.9	6.8	4.2	5.1	6.8	8.5	3.7	-	-	-	-	-	-	-	8.5	5.1	-	-
11473	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11726	16.6	253.2	138.1	83.0	-	66.3	66.3	-	83.0	19.0	-	21.7	29.2	31.4	0.0	39.9	38.6	253.2	65.9	25.4	27.5
12685	53.0	42.4	24.7	76.2	67.2	67.2	69.2	53.0	71.3	61.7	28.9	37.2	11.4	14.7	12.6	10.9	103.4	76.2	55.9	24.3	35.4
13565	27.6	29.0	28.3	29.0	22.1	12.4	16.6	20.7	27.6	20.3	-	61.7	-	-	-	-	-	29.0	21.2	30.9	-
13716	-	-	-	7.8	-	-	-	9.9	-	28.8	23.1	29.8	24.5	10.1	-	-	-	28.8	6.3	27.2	2.5
14222	25.0	25.1	19.3	6.2	13.5	24.0	24.4	-	30.8	14.0	-	-	-	-	-	-	-	30.8	16.6	-	-
14401	102.1	174.2	144.8	186.3	114.2	127.1	121.5	114.2	153.2	147.2	113.5	118.7	156.7	90.6	34.1	80.1	41.7	186.3	136.2	137.7	61.6
14706	33.6	71.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	71.9	9.6	-	-
15564	21.6	31.3	30.1	25.9	38.3	54.3	49.6	20.7	19.1	14.0	-	4.0	-	-	-	-	-	54.3	27.7	2.0	-
15747	52.6	55.2	139.9	141.4	137.0	63.3	75.1	91.3	91.3	83.1	37.6	38.7	-	36.2	46.6	48.0	26.6	141.4	88.0	19.3	39.3
15957	18.7	-	-	-	-	61.5	-	-	-	64.2	6.2	-	-	-	13.3	-	19.6	64.2	13.7	-	8.2
16366	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16398	-	36.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36.3	3.3	-	-
16740	4.6	5.5	4.8	4.6	-	-	-	52.2	-	-	-	-	-	-	-	-	-	52.2	6.5	-	-
17872	149.1	214.4	100.6	101.3	74.6	303.8	334.2	324.1	322.0	210.0	108.0	40.0	47.0	74.0	66.0	86.0	96.0	334.2	203.8	43.5	80.5
18217	-	-	-	-	-	-	-	-	132.6	-	-	-	-	-	-	-	-	132.6	12.1	-	-
18670	139.7	198.8	160.0	201.7	213.6	231.6	251.5	95.0	239.3	207.3	107.3	83.1	143.0	128.8	109.0	98.1	138.7	251.5	186.0	113.1	118.7
18685	20.3	30.4	30.4	-	50.6	35.0	38.0	46.4	47.7	64.9	41.3	58.2	58.1	52.9	40.4	48.8	48.1	64.9	36.8	58.1	47.6
18701	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19077	77.3	112.0	145.8	121.5	-	214.3	218.8	218.8	219.9	131.0	73.0	-	43.0	76.0	68.0	104.0	85.0	219.9	139.3	21.5	83.3
19262	6.6	8.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.8	1.4	-	-
20554	73.7	70.0	73.7	117.8	154.7	151.0	165.7	156.5	165.7	85.0	102.0	74.0	34.0	92.0	23.0	40.0	117.0	165.7	119.6	54.0	68.0
22251	21.2	31.8	37.1	42.4	47.1	53.8	-	57.4	61.9	52.4	47.2	52.3	-	-	-	-	-	61.9	41.1	26.1	-
22527	11.4	26.1	17.0	17.3	22.5	20.5	27.3	28.1	34.1	50.2	31.1	51.2	29.8	30.5	-	-	-	50.2	26.0	40.5	7.6
23052	-	-	-	-	-	-	-	-	-	12.2	-	29.8	6.7	-	-	-	-	12.2	1.1	18.2	-

Appendix E-2

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS)

ac-ft used

Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Max 1994 - 2004	Averages 1994 - 2004	Averages 2005 - 2006	Averages 2007 - 2010
23245	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23445	26.5	35.0	26.5	23.9	26.5	26.5	37.1	31.8	-	29.5	9.6	-	13.0	16.1	12.3	16.0	18.9	37.1	24.8	6.5	15.8
24605	34.5	72.9	74.6	175.0	66.3	77.8	141.4	130.2	32.3	113.6	83.2	27.8	41.7	43.3	13.7	28.6	41.7	175.0	91.1	34.8	31.8
24963	35.8	36.5	41.4	53.9	58.3	104.4	136.2	80.5	94.8	41.3	30.0	42.9	63.1	56.1	4.2	63.7	-	136.2	64.8	53.0	31.0
26671	18.0	19.3	16.6	20.0	20.7	22.1	15.2	20.7	23.5	57.3	58.4	13.3	36.6	40.3	15.9	-	-	58.4	26.5	24.9	14.0
27069	46.4	74.1	74.1	74.6	74.8	74.5	74.1	74.0	74.1	50.0	36.3	31.7	29.2	51.9	29.8	36.5	37.9	74.8	66.1	30.4	39.0
28251	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28965	39.3	-	49.1	-	13.7	-	-	-	-	-	-	17.0	20.6	32.0	-	-	-	49.1	9.3	18.8	8.0
28998	67.3	30.2	6.0	-	-	86.9	-	-	-	-	152.5	148.7	221.3	54.2	-	79.1	78.7	152.5	31.2	185.0	53.0
29842	76.1	111.0	94.9	68.5	70.0	99.8	-	70.4	136.0	121.9	-	-	5.1	52.4	69.1	57.9	100.5	136.0	77.1	2.6	70.0
30004	-	-	-	-	-	2.0	2.3	-	-	-	-	-	-	-	-	-	-	2.3	0.4	-	-
30023	23.5	24.2	24.2	22.1	23.5	22.1	16.6	20.7	24.9	46.5	23.0	18.0	44.6	20.3	31.9	14.7	29.5	46.5	24.6	31.3	24.1
30097	-	3.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	0.3	-	-
30541	67.0	30.2	24.3	80.8	74.2	-	111.4	143.8	-	-	-	-	-	-	-	-	-	143.8	48.3	-	-
32412	-	-	71.6	-	-	75.1	-	-	-	-	-	-	-	-	-	-	-	75.1	13.3	-	-
32416	-	-	-	-	-	-	60.4	-	-	-	-	-	-	-	-	-	-	60.4	5.5	-	-
32599	80.3	63.8	59.8	56.7	52.7	53.7	64.3	61.0	69.3	87.2	56.9	90.7	78.1	63.0	41.5	57.6	-	87.2	64.2	84.4	40.5
32609	27.6	138.1	55.2	43.4	-	12.4	30.9	-	40.0	-	-	-	-	-	-	-	-	138.1	31.6	-	-
32876	11.1	39.7	-	-	38.3	48.2	47.5	19.7	74.2	36.0	78.0	50.0	44.0	66.0	36.0	47.0	45.0	78.0	35.7	47.0	48.5
33523	14.4	23.0	25.3	20.7	33.6	33.1	36.5	31.8	33.1	-	-	43.0	-	-	-	-	-	36.5	22.9	21.5	-
33557	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34798	125.2	235.7	224.6	21.4	158.4	-	-	148.4	174.4	-	-	-	-	-	-	-	-	235.7	98.9	-	-
34918	39.8	47.7	47.7	82.9	79.5	99.4	92.8	63.6	117.7	75.9	27.3	61.7	77.6	61.8	47.8	56.0	27.3	117.7	70.4	69.7	48.2
35640	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35713	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35952	70.7	70.7	65.0	73.8	65.0	84.7	84.8	-	-	-	-	-	-	-	-	-	-	84.8	46.8	-	-
36486	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37038	59.4	62.0	-	67.3	77.9	-	83.7	45.1	58.4	43.1	30.4	79.0	50.5	53.9	7.0	46.1	72.3	83.7	47.9	64.8	44.8
37590	34.0	36.7	158.6	33.7	75.2	62.4	66.5	53.6	76.8	56.9	54.9	41.7	28.0	25.2	31.9	33.6	31.7	158.6	64.5	34.8	30.6
38380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38423	-	-	-	-	-	92.4	124.8	96.3	58.4	-	-	-	-	-	-	-	-	124.8	33.8	-	-
38611	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38640	20.4	74.2	15.7	39.8	71.2	55.5	138.5	72.4	94.2	34.1	-	-	26.8	-	-	-	-	138.5	56.0	13.4	-
39062	8.8	11.7	-	-	8.8	-	13.3	-	-	8.2	-	-	-	-	-	-	-	13.3	4.6	-	-
39218	2.0	4.2	6.8	4.2	4.2	6.8	7.6	4.2	4.2	5.1	-	2.0	-	0.5	-	-	13.3	7.6	4.5	1.0	3.5
39254	24.3	9.9	35.4	35.4	28.7	30.9	35.4	29.1	39.8	32.8	36.8	5.0	-	-	-	12.0	-	39.8	30.8	2.5	3.0
39763	-	27.5	4.4	-	55.7	-	-	-	-	-	-	-	-	-	-	-	-	55.7	8.0	-	-
40259	-	-	-	13.3	-	7.7	-	7.7	11.1	-	-	-	-	-	-	-	-	13.3	3.6	-	-
40535	47.6	54.7	51.7	49.9	114.0	53.7	98.5	153.1	73.9	67.1	61.4	41.9	65.9	51.8	37.6	60.8	38.2	153.1	75.1	53.9	47.1
42109	30.2	55.2	54.3	57.1	46.0	47.9	48.6	51.6	47.9	72.0	-	-	-	-	-	-	-	72.0	46.4	-	-
42635	-	-	-	-	-	-	14.1	-	5.9	-	-	-	-	-	-	-	-	14.1	1.8	-	-
44430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44434	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45252	46.0	36.0	7.5	71.2	37.6	44.0	59.4	59.4	69.1	63.8	38.7	31.6	42.9	49.5	52.4	77.2	70.5	71.2	48.4	37.2	62.4
45309	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45387	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46584	39.8	30.0	58.2	69.1	49.9	58.2	92.1	117.8	104.4	81.0	85.8	105.0	92.8	88.4	40.0	17.6	58.2	117.8	71.5	98.9	51.0
46853	17.7	23.9	23.7	34.5	22.3	54.3	44.2	46.8	67.0	-	87.5	128.0	135.4	-	29.5	48.8	52.4	87.5	38.3	131.7	32.6
47600	38.0	43.7	30.4	-	-	22.1	-	-	-	-	-	-	-	-	-	-	-	43.7	12.2	-	-
48016	8.0	57.9	14.1	24.7	21.2	21.2	26.5	21.2	24.7	6.5	22.1	29.6	-	-	-	-	-	57.9	22.6	14.8	-
48453	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48985	-	-	-	-	-	-	474.6	159.8	462.6	898.6	-	-	-	-	-	-	-	898.6	181.4	-	-
49744	6.9	78.3	-	27.0	-	9.9	9.9	-	20.0	-	-	-	-	-	-	-	-	78.3	13.8	-	-
51169	-	-	-	-	54.9	73.6	115.3	83.5	120.7	85.6	78.6	68.5	25.1	49.6	26.7	83.8	60.5	120.7	55.7	46.8	55.2
51531	-	5.5	-	4.3	11.5	15.7	28.6	12.9	36.6	13.2	-	-	-	-	-	-	-	36.6	11.7	-	-
52618	8.5	117.5	-	110.6	97.2	65.2	114.1	68.4	101.3	76.2	56.8	62.3	63.6	60.0	45.1	63.9	59.1	117.5	74.2	63.0	57.0
53916	-	-	-	3.9	-	-	-	11.9	28.0	14.1	-	7.6	9.7	-	-	-	-	28.0	5.3	8.6	-
54029	-	-	-	-	-	169.4	-	-	-	77.9	69.0	131.6	133.7	78.3	31.1	23.6	117.2	169.4	28.8	132.6	62.5

Appendix E-2

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS)

ac-ft used

Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Max 1994 - 2004	Averages 1994 - 2004	Averages 2005 - 2006	Averages 2007 - 2010
54274	18.6	18.4	18.9	10.6	6.8	18.9	12.4	21.2	25.6	25.8	-	-	-	-	-	-	-	25.8	16.1	-	-
54870	-	-	-	-	-	-	160.0	128.0	-	24.8	76.9	43.8	48.4	49.3	-	-	-	160.0	35.4	46.1	12.3
66064	-	-	-	-	-	-	-	67.0	52.1	56.8	41.7	31.9	-	-	-	16.5	-	67.0	19.8	16.0	4.1
66322	-	-	-	-	-	-	-	-	-	-	-	31.3	63.5	52.9	44.9	152.0	92.0	-	-	47.4	85.5
67543	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
69387	-	-	-	-	-	-	-	-	-	75.8	82.7	105.8	85.7	54.2	32.1	24.2	52.0	82.7	14.4	95.8	40.6
69744	-	-	-	-	-	-	-	-	-	-	56.3	55.1	55.7	49.4	41.7	85.7	50.7	56.3	5.1	55.4	56.9
70484	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72714	-	-	-	-	-	-	-	-	-	-	-	-	45.0	37.6	26.9	70.9	93.1	-	-	22.5	57.1
75478	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.3	38.9	25.9	-	-	-	20.2
Total	2,679	4,328	3,441	3,562	3,325	4,169	5,304	4,283	5,212	4,277	2,647	**2,697**	**2,661**	2,249	1,515	2,257	2,423	**5,304**	3,930	2,679	2,111
Average	21.6	34.9	27.8	28.7	26.8	33.6	42.8	34.5	42.0	34.5	21.3	21.7	21.5	18.1	12.2	18.2	19.5	42.8	31.7	21.6	17.0
Additional Diversions												**1,233**	**1,269**								

Note: Pdiv_ID list consists of active irrigation surface water rights located between Spring Creek and Clay Center, KS, including mainstem and some tributaries, and senior to MDS.
Additional Diversions = Average (1994 - 2004) - Total Actual for the specific year

Removed Pdivs based on correspondence with KDWR

693	23.9	53.0	37.6	42.4	63.6	-	39.8	91.8	133.6	57.0	50.0	75.5	58.0	80.6	42.3	48.0	28.8	133.6	53.9	66.8	49.9
10342	19.9	18.4	77.3	29.0	22.4	25.9	24.9	19.9	-	-	21.8	19.9	7.8	-	16.8	8.4	13.9	77.3	23.6	13.8	9.8
14859	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19256	30.9	-	42.0	27.8	42.4	-	-	-	-	50.9	66.0	71.9	62.8	76.3	39.1	54.0	39.8	66.0	23.6	67.3	52.3
32224	19.9	42.4	31.8	15.9	31.8	39.8	39.8	39.8	25.8	21.8	26.1	13.3	22.1	19.4	13.9	15.8	17.9	42.4	30.4	17.7	16.8
37311	83.5	51.0	22.7	-	-	68.2	141.2	85.9	133.0	-	-	-	-	-	-	-	-	141.2	53.2	-	-
40599	7.0	23.9	13.9	18.8	24.2	36.5	43.8	31.8	54.8	28.1	34.6	27.7	22.4	18.4	12.9	24.9	33.6	54.8	28.8	25.0	22.5
52743	-	32.9	37.3	43.5	47.8	39.1	52.4	35.6	27.3	-	-	41.0	-	-	-	-	-	52.4	28.7	20.5	-
70230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70231	-	-	-	-	-	-	-	-	-	-	-	-	-	29.0	-	-	-	-	-	-	7.3
70232	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	185	222	263	177	232	209	342	305	374	158	199	249	173	224	125	151	134	374	242	211	158
Average	17	20	24	16	21	19	31	28	34	14	18	23	16	20	11	14	12	34	22	19	14

List of Pdiv_IDs with Senior SW Files with overlapping (place of use) Junior GW Files that are also senior to MDS

1867	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3052	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17165	-	9.2	31.3	35.0	17.7	32.4	29.1	34.2	20.0	102.8	138.9	81.5	94.3	10.3	24.8	22.7	11.1	138.9	41.0	87.9	17.2
17379	38.7	58.9	70.0	68.1	68.1	70.0	66.3	68.1	68.1	51.7	31.1	19.0	38.2	46.3	34.3	5.7	27.8	70.0	59.9	28.6	28.5
20976	-	-	-	-	-	82.9	109.9	102.9	-	-	-	-	-	-	-	-	-	109.9	26.9	-	-
32182	25.8	9.7	20.7	29.7	13.8	13.8	13.8	16.6	15.2	-	-	27.0	21.0	-	12.0	-	19.0	29.7	14.5	24.0	7.8
34326	39.9	40.6	48.1	100.8	100.3	82.9	-	-	98.2	75.1	78.7	66.5	80.5	113.5	74.9	38.0	29.7	100.8	60.4	73.5	64.0
42797	-	-	16.6	40.0	35.7	36.5	29.1	34.2	-	-	-	-	-	-	-	-	-	40.0	17.5	-	-
47289	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51273	-	113.7	88.1	107.6	111.4	119.0	173.2	128.8	241.7	393.9	85.8	-	-	-	68.0	21.1	47.7	393.9	142.1	-	34.2
Total	104	232	275	381	347	437	421	385	443	624	334	194	234	170	214	87	135	624	362	214	152
Average	10	23	27	38	35	44	42	38	44	62	33	19	23	17	21	9	14	62	36	21	15

Appendix E-3

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS)

acres irrigated

																		Max	Averages		
Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	1994 - 2004	1994 - 2004	2005 - 2006	2007 - 2010
103	-	33	35	-	35	34	35	34	32	26	35	-	-	30	-	-	-	35	27	-	8
483	-	-	-	-	34	36	-	-	-	-	-	-	-	-	-	-	-	36	6	-	-
493	103	130	130	130	130	133	133	134	134	134	134	134	135	136	136	136	136	134	130	135	136
931	125	125	125	125	125	125	125	125	120	100	100	100	80	80	80	100	100	125	120	90	90
951	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	7	1	-	-
1203	-	-	-	-	-	158	-	-	-	-	-	-	-	-	-	-	-	158	14	-	-
2333	-	-	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35	3	-	-
2510	50	35	60	37	40	10	11	-	-	-	-	-	-	-	-	-	-	60	22	-	-
2540	-	-	29	29	30	30	30	30	30	-	-	-	-	-	30	-	-	30	19	-	8
2645	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3786	107	60	117	117	60	44	54	52	55	18	33	39	64	-	-	-	-	117	65	52	-
3897	125	125	120	120	120	120	120	120	120	120	120	120	120	-	-	120	120	125	121	120	60
3993	-	45	-	45	-	-	35	42	43	-	43	27	43	45	30	45	25	45	23	35	36
4575	-	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	5	-	-
4741	48	32	32	30	28	28	28	28	28	28	28	-	-	30	30	30	30	48	31	-	30
4925	26	35	26	77	78	78	78	78	78	103	40	40	40	40	40	40	145	103	63	40	66
5069	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6161	-	6	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1	-	-
6216	18	18	18	-	-	17	18	-	-	-	-	-	-	-	-	-	20	18	8	-	5
6268	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6592	130	130	130	130	-	-	-	-	-	-	-	-	-	-	-	-	-	130	47	-	-
6606	18	18	18	19	18	18	18	18	20	-	19	18	19	9	-	-	-	20	17	19	2
7313	-	4	-	-	-	-	-	-	-	-	29	-	-	-	-	-	-	29	3	-	-
8357	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8637	48	50	48	45	48	48	48	48	48	48	47	47	47	-	47	47	48	50	48	47	36
9191	25	25	25	25	25	25	25	25	25	25	25	25	-	-	25	25	25	25	25	13	19
9964	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10073	60	-	50	45	45	45	45	45	45	45	45	45	-	-	-	-	-	60	43	23	-
10082	60	60	60	60	60	73	73	57	57	57	57	57	56	57	57	57	57	73	61	57	57
10675	87	87	24	97	90	90	90	90	90	90	90	99	99	99	99	99	99	97	84	99	99
11192	16	13	10	13	14	13	10	10	13	10	-	-	-	-	-	-	-	16	11	-	-
11473	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11726	145	135	130	65	130	130	130	-	135	130	130	130	130	135	100	130	130	145	115	130	124
12685	53	53	53	53	53	53	53	53	53	60	53	63	39	40	30	20	150	60	54	51	60
13565	60	40	60	60	60	35	60	30	60	25	-	60	-	-	-	-	-	60	45	30	-
13716	-	-	-	32	-	-	-	25	-	30	51	46	40	45	-	-	-	51	13	43	11
14222	57	58	58	25	40	85	80	-	80	45	-	-	-	-	-	-	-	85	48	-	-
14401	120	120	120	120	148	148	148	148	148	148	140	140	140	140	140	140	140	148	137	140	140
14706	35	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35	6	-	-
15564	40	63	63	62	84	84	84	44	44	20	-	20	-	-	-	-	-	84	53	10	-
15747	50	70	80	80	70	85	85	85	80	55	65	65	-	70	80	80	80	85	73	33	78
15957	21	-	-	-	-	45	-	-	-	43	43	-	-	-	15	-	18	45	14	-	8
16366	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16398	-	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	3	-	-
16740	24	24	24	24	-	-	-	80	-	-	-	-	-	-	-	-	-	80	16	-	-
17872	200	280	245	160	160	310	310	310	310	310	310	115	46	90	82	150	155	310	264	81	119
18217	-	-	-	-	-	-	-	-	110	-	-	-	-	-	-	-	-	110	10	-	-
18670	180	208	175	178	176	177	177	177	177	174	175	177	176	173	173	173	191	208	179	177	178
18685	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
18701	-	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	30	3	-	-
19077	240	240	180	240	-	215	200	205	205	205	205	-	42	90	91	105	150	240	194	21	109

Appendix E-3

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS)

acres irrigated

Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Max 1994 - 2004	Averages 1994 - 2004	Averages 2005 - 2006	Averages 2007 - 2010
19262	16	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	3	-	-
20554	80	80	80	80	111	111	111	111	111	80	80	80	110	110	110	110	110	111	94	95	110
22251	75	75	75	75	75	75	-	75	75	75	75	75	-	-	-	-	-	75	68	38	-
22527	27	27	26	46	48	52	52	52	52	52	52	52	52	52	-	-	-	52	44	52	13
23052	-	-	-	-	-	-	-	-	-	-	-	62	61	-	-	-	-	-	-	62	-
23245	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23445	23	24	23	23	23	23	31	23	-	23	23	-	24	24	24	23	23	31	22	12	24
24605	48	50	80	80	80	65	110	165	27	120	130	40	250	250	102	85	100	165	87	145	134
24963	55	27	31	31	54	51	82	52	55	55	31	60	49	48	48	77	-	82	48	55	43
26671	35	45	30	45	45	45	45	45	45	40	40	40	40	40	15	-	-	45	42	40	14
27069	110	110	110	110	110	110	110	110	110	110	110	135	110	110	100	70	110	110	110	123	98
28251	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28965	24	-	45	-	44	-	-	-	-	-	-	16	43	45	-	-	-	45	10	30	11
28998	96	74	37	-	-	191	-	-	-	-	191	191	191	191	-	191	191	191	54	191	143
29842	92	88	91	91	90	85	-	90	90	93	-	-	35	80	95	95	95	93	74	18	91
30004	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	3	1	-	-
30023	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
30097	-	24	-	24	-	-	-	-	-	-	-	-	-	-	-	-	-	24	4	-	-
30541	95	85	154	191	191	-	191	217	-	-	-	-	-	-	-	-	-	217	102	-	-
32412	-	-	60	-	-	59	-	-	-	-	-	-	-	-	-	-	-	60	11	-	-
32416	-	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	75	7	-	-
32599	63	44	42	42	42	42	42	-	60	60	60	66	66	66	66	66	-	63	45	66	50
32609	30	39	26	29	27	33	38	-	38	-	-	-	-	-	-	-	-	39	24	-	-
32876	17	18	-	-	18	18	18	18	28	61	59	59	59	59	59	59	18	61	23	59	49
33523	32	32	32	32	32	32	32	32	32	-	-	31	-	-	-	-	-	32	26	16	-
33557	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34798	230	230	230	230	230	-	-	230	220	-	-	-	-	-	-	-	-	230	145	-	-
34918	82	82	82	82	82	82	82	82	82	75	82	86	110	82	105	115	45	82	81	98	87
35640	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35713	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35952	60	65	65	65	65	65	65	-	-	-	-	-	-	-	-	-	-	65	41	-	-
36486	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37038	62	60	-	60	60	-	59	90	85	87	87	87	87	90	90	90	90	90	59	87	90
37590	28	24	87	50	80	60	60	60	60	60	81	60	60	60	60	60	60	87	59	60	60
38380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38423	-	-	-	-	-	80	80	80	80	-	-	-	-	-	-	-	-	80	29	-	-
38611	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38640	50	55	50	50	50	50	50	50	50	25	-	-	25	-	-	-	-	55	44	13	-
39062	10	10	-	-	9	-	9	-	-	9	-	-	-	-	-	-	-	10	4	-	-
39218	7	10	13	10	9	10	13	13	10	13	-	13	-	10	-	-	10	13	10	7	5
39254	62	29	60	65	65	65	65	65	65	65	65	65	-	-	-	65	-	65	61	33	16
39763	-	55	55	55	46	-	-	-	-	-	-	-	-	-	-	-	-	55	19	-	-
40259	-	-	-	9	-	9	-	9	9	-	-	-	-	-	-	-	-	9	3	-	-
40535	103	103	103	103	103	78	78	128	57	57	57	56	57	57	57	57	57	128	88	57	57
42109	45	43	42	42	42	42	42	42	42	42	-	-	-	-	-	-	-	45	39	-	-
42635	-	-	-	-	-	-	7	-	7	-	-	-	-	-	-	-	-	7	1	-	-
44430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44434	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45252	27	30	30	30	30	30	30	30	302	30	32	30	32	32	32	32	32	302	55	31	32
45309	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45387	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46584	40	30	34	74	40	70	75	75	70	75	75	75	78	78	80	80	80	75	60	77	80

Appendix E-3

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS)
acres irrigated

																		Max	Averages		
Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	1994 - 2004	1994 - 2004	2005 - 2006	2007 - 2010
46853	27	29	30	30	30	30	30	30	30	-	73	73	72	-	72	72	72	73	31	73	54
47600	60	60	60	-	-	30	-	-	-	110	-	-	-	-	-	-	-	110	29	-	-
48016	29	61	30	29	29	29	29	29	29	29	29	29	-	-	-	-	-	61	32	15	-
48453	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48985	-	32	-	-	-	-	500	463	960	993	-	-	-	-	-	-	-	993	268	-	-
49744	120	25	-	25	30	20	20	-	141	30	-	-	-	-	-	-	-	141	37	-	-
51169	-	-	-	-	130	130	130	130	130	130	130	130	130	130	130	130	150	130	83	130	135
51531	-	29	-	29	29	29	29	29	29	29	-	-	-	-	-	-	-	29	21	-	-
52618	60	60	-	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	91	110	110
53916	-	-	-	30	-	-	-	30	34	32	-	30	30	-	-	-	-	34	11	30	-
54029	-	-	-	-	-	230	-	-	-	110	100	110	110	110	110	54	76	230	40	110	88
54274	22	14	15	21	21	25	15	17	20	25	-	-	-	-	-	-	-	25	18	-	-
54870	-	-	-	-	-	-	100	100	-	100	100	100	100	100	-	-	-	100	36	100	25
66064	-	-	-	-	-	-	-	65	70	70	65	72	-	-	-	72	-	70	25	36	18
66322	-	-	-	-	-	-	-	-	-	-	-	45	72	72	72	214	280	-	-	59	160
67543	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
69387	-	-	-	-	-	-	-	-	-	110	120	140	110	110	110	56	34	120	21	125	78
69744	-	-	-	-	-	-	-	-	-	-	80	80	80	80	80	80	80	80	7	80	80
70484	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
72714	-	-	-	-	-	-	-	-	-	-	-	-	75	75	75	205	205	-	-	38	140
75478	-	-	-	-	-	-	-	-	-	-	-	-	-	-	96	96	96	-	-	-	72
Total	4,378	4,447	4,333	4,412	4,246	4,826	4,986	5,105	5,820	5,336	4,219	**3,930**	**3,809**	3,645	3,248	3,926	4,008	**5,820**	4,737	3,870	3,707
Average	35	36	35	36	34	39	40	41	47	43	34	32	31	29	26	32	32	47	38	31	30
Additional Acres												**807**	**928**								

Note: Pdiv_ID list consists of active irrigation surface water rights located between Spring Creek and Clay Center, KS, including mainstem and some tributaries, and senior to MDS.
Additional Acres = Average (1994 - 2004) - Total Actual for the specific year

Appendix E-4

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS) Above Spring Creek

ac-ft used

Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Max 1994 - 2004	Averages 1994 - 2004	Averages 2005 - 2006	Averages 2007 - 2010
2346	133.6	149.1	144.2	146.2	142.5	145.8	-	-	-	-	12.4	-	-	-	-	62.0	59.2	149.1	79.4	-	30.3
3706	-	-	-	-	-	-	-	6.4	7.4	-	-	-	-	-	-	-	-	7.4	1.3	-	-
3881	81.5	87.7	-	82.2	85.2	82.9	87.2	82.2	77.3	55.0	38.0	29.0	-	-	26.0	-	11.0	87.7	69.0	14.5	9.3
9254	19.4	79.5	79.5	-	-	-	40.5	60.1	120.8	53.6	38.7	10.8	-	55.1	24.2	14.7	55.5	120.8	44.7	5.4	37.4
9548	51.6	95.0	-	77.9	95.7	91.6	95.7	93.9	66.0	106.0	106.0	106.0	58.0	59.0	51.0	92.0	91.0	106.0	79.9	82.0	73.3
12015	55.2	73.7	-	23.2	-	58.9	29.5	69.0	55.2	125.6	76.4	75.5	75.3	66.8	11.2	57.6	78.2	125.6	51.5	75.4	53.4
12073	55.2	92.1	58.9	33.1	29.5	58.9	41.4	55.2	51.6	111.2	-	-	-	-	-	-	-	111.2	53.4	-	-
15172	44.6	8.1	83.1	91.3	63.9	107.4	47.1	59.5	81.3	34.8	-	-	-	-	-	-	-	107.4	56.5	-	-
18282	5.5	79.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	79.2	7.7	-	-
20754	-	29.7	37.3	39.4	30.1	47.9	47.7	-	-	40.7	39.3	43.3	-	28.3	27.2	44.4	47.0	47.9	28.4	21.6	36.7
24101	93.9	60.8	53.0	26.5	99.0	56.6	47.7	47.7	79.5	106.3	75.4	79.2	80.9	67.7	56.7	69.5	69.3	106.3	67.9	80.0	65.8
25554	77.3	81.0	84.7	202.5	191.5	206.2	206.2	204.4	206.2	83.0	106.0	87.0	44.0	83.0	87.0	60.0	108.0	206.2	149.9	65.5	84.5
26958	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27020	-	-	77.3	-	-	36.8	55.2	-	79.5	-	3.0	-	-	-	-	-	-	79.5	22.9	-	-
27146	11.0	8.9	6.7	27.8	21.5	24.6	46.4	49.1	42.0	-	34.9	-	-	-	-	-	-	49.1	24.8	-	-
35503	91.0	84.4	82.8	60.6	40.6	34.8	10.0	0.0	-	65.1	10.1	165.8	34.8	3.4	13.6	19.1	37.2	91.0	43.6	100.3	18.3
36948	18.8	44.2	15.7	46.0	23.9	18.4	47.1	23.0	22.1	127.4	-	-	-	92.1	44.2	20.0	84.6	127.4	35.1	-	60.2
37938	15.0	15.7	14.5	32.9	12.0	19.7	18.7	53.9	65.1	41.6	-	26.1	30.1	27.4	33.0	23.1	21.8	65.1	26.3	28.1	26.3
40768	55.2	78.6	60.8	56.2	71.8	67.4	93.9	77.3	108.3	95.7	51.7	89.8	80.4	51.8	34.5	47.5	82.5	108.3	74.3	85.1	54.1
44268	44.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44.3	4.0	-	-
44958	33.9	20.7	30.8	25.8	5.3	6.2	11.0	11.0	27.0	17.6	21.4	25.3	26.4	14.7	-	-	30.9	33.9	19.2	25.8	11.4
46100	-	-	-	-	33.1	28.7	29.7	29.0	-	-	-	-	-	-	-	-	-	33.1	11.0	-	-
46392	-	-	82.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82.9	7.5	-	-
47218	-	-	88.4	-	36.8	-	-	-	-	-	-	-	-	-	-	-	-	88.4	11.4	-	-
49746	17.7	89.1	59.7	53.6	71.8	70.7	95.2	39.8	51.7	30.6	14.8	-	3.8	20.7	5.5	17.3	54.1	95.2	54.1	1.9	24.4
50101	47.9	212.1	191.5	141.4	143.6	142.9	156.1	150.3	165.0	81.8	34.9	60.0	36.7	23.5	26.0	39.3	62.9	212.1	133.4	48.3	37.9
51928	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51964	125.2	132.6	139.9	313.0	300.1	320.4	322.2	316.7	320.4	242.0	214.0	107.0	95.0	179.0	148.0	143.0	194.0	322.2	249.7	101.0	166.0
60939	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61807	-	-	-	-	63.0	58.3	96.0	6.0	67.0	62.0	22.0	46.0	44.0	65.0	18.0	54.0	56.0	96.0	34.0	45.0	48.3
67305	-	-	-	-	-	-	-	-	40.0	-	-	-	-	-	-	-	-	40.0	3.6	-	-
Total	1,078	1,522	1,392	1,480	1,561	1,685	1,625	1,435	1,733	1,480	899	**951**	**609**	838	606	763	1,143	**1,733**	1,445	780	838
Average	34.8	49.1	44.9	47.7	50.4	54.4	52.4	46.3	55.9	47.7	29.0	30.7	19.7	27.0	19.6	24.6	36.9	55.9	46.6	25.2	27.0
Additional Diversions												**494**	**835**								

Note: Pdiv_ID list consists of active irrigation surface water rights senior to MDS and located on the Republican River between the Stateline and Spring Creek.

Additional Diversions = Average (1994 - 2004) - Total Actual for the specific year

Removed Pdivs based on correspondence wit KDWR

12200	26.0	21.9	13.2	12.7	92.4	133.6	124.4	72.4	95.0	89.8	87.1	65.8	43.3	102.5	81.1	81.1	100.2	133.6	69.9	54.5	91.2
18346	14.0	14.7	10.4	7.2	50.3	25.9	45.5	69.3	43.0	47.4	51.7	30.0	-	6.4	21.4	53.0	46.4	69.3	34.5	15.0	31.8
22230	39.2	41.4	116.0	116.0	117.1	118.2	-	-	49.7	46.1	83.1	22.8	-	9.3	29.6	44.7	84.4	118.2	66.1	11.4	42.0
43044	12.9	11.8	36.8	3.7	5.5	5.9	28.3	28.3	-	29.4	0.1	6.8	-	-	27.6	37.5	20.9	36.8	14.8	3.4	21.5
46376	19.3	22.1	47.9	47.9	45.1	43.7	15.3	14.3	6.9	9.0	1.7	1.7	-	-	10.0	10.2	18.3	47.9	24.8	0.9	9.6
54647	6.4	7.0	9.2	7.4	8.1	8.5	5.6	5.2	5.5	1.8	-	-	-	-	10.5	7.7	10.5	9.2	5.9	-	7.2
54918	46.4	43.1	122.6	99.4	105.0	101.6	73.7	65.2	55.2	4.5	0.3	-	-	6.0	6.8	16.1	0.8	122.6	65.2	-	7.4
Total	164.3	162.0	356.1	294.2	423.5	437.5	292.8	254.5	255.4	228.0	224.0	127.0	43.3	124.2	186.9	250.3	281.5	437.5	281.1	85.2	210.7
Average	23.5	23.1	50.9	42.0	60.5	62.5	41.8	36.4	36.5	32.6	32.0	18.1	6.2	17.7	26.7	35.8	40.2	62.5	40.2	12.2	30.1

Appendix E-5

Republican River Active Surface Water Rights Senior to the Minimum Desirable Streamflow (MDS) Above Spring Creek

acres irrigated

Pdiv_ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Max 1994 - 2004	Averages 1994 - 2004	Averages 2005 - 2006	Averages 2007 - 2010
2346	117	117	117	117	117	117	-	117	117	-	60	-	-	-	-	120	120	117	91	-	60
3706	-	-	-	-	-	-	-	40	40	-	-	-	-	-	-	-	-	40	7	-	-
3881	73	73	-	73	73	73	73	73	73	73	73	73	-	-	73	-	73	73	66	37	37
9254	41	73	75	-	-	-	90	90	168	168	168	168	-	168	168	168	168	168	79	84	168
9548	55	66	-	76	68	55	70	70	70	120	120	120	120	120	120	120	120	120	70	120	120
12015	65	70	-	65	-	65	65	65	65	65	65	58	40	58	40	58	58	70	54	49	54
12073	58	60	58	58	58	58	58	58	58	58	-	-	-	-	-	-	-	60	53	-	-
15172	88	84	87	87	87	87	87	87	87	87	-	-	-	-	-	-	-	88	79	-	-
18282	25	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	71	9	-	-
20754	-	44	44	44	37	44	44	-	-	39	39	39	-	40	40	40	40	44	30	20	40
24101	62	60	27	27	58	27	27	27	27	51	74	74	74	88	88	88	88	74	42	74	88
25554	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
26958	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27020	-	-	39	-	-	55	55	-	56	-	31	-	-	-	-	-	-	56	21	-	-
27146	22	22	22	22	30	30	30	30	30	-	52	-	-	-	-	-	-	52	26	-	-
35503	171	171	171	171	25	25	25	25	-	82	25	140	25	28	25	25	25	171	81	83	26
36948	65	52	55	75	60	80	120	60	60	75	-	-	-	80	80	80	80	120	64	-	80
37938	30	30	30	30	22	22	22	22	89	52	-	52	52	52	52	52	52	89	32	52	52
40768	100	100	100	100	110	111	111	111	110	111	109	109	109	109	107	105	108	111	107	109	107
44268	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	5	-	-
44958	32	33	35	35	35	40	40	40	40	40	40	40	40	40	-	-	40	40	37	40	20
46100	-	-	-	-	22	23	30	30	-	-	-	-	-	-	-	-	-	30	10	-	-
46392	-	-	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	7	-	-
47218	-	-	65	-	65	-	-	-	-	-	-	-	-	-	-	-	-	65	12	-	-
49746	54	55	55	55	55	56	56	56	55	56	56	-	30	55	28	57	57	56	55	15	49
50101	90	110	100	90	100	100	100	100	100	120	120	120	120	120	120	120	120	120	103	120	120
51928	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51964	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216
60939	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61807	-	-	-	-	70	72	72	72	72	72	76	76	76	76	76	76	76	76	46	76	76
67305	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	-	30	3	-	-
Total	1,529	1,622	1,484	1,456	1,423	1,471	1,506	1,504	1,678	1,600	1,439	**1,400**	**1,017**	1,365	1,348	1,440	1,556	**1,678**	1,519	1,209	1,427
Average	49	52	48	47	46	47	49	49	54	52	46	45	33	44	43	46	50	54	49	39	46
Additional Acres												**119**	**502**								

Note: Pdiv_ID list consists of active irrigation surface water rights senior to MDS and located on the Republican River between the Stateline and Spring Creek.

Additional Acres = Average (1994 - 2004) - Total Actual for the specific year