

Slattery Aqua Engineering LLC

8357 Windhaven Drive, Parker, CO 80134 Office: (720) 851-1619 Fax: (303) 840-2575 email: SlatteryAquaEngineering@comcast.net

February 16, 2009

Peter J. Ampe
First Assistant Attorney General
Federal and Interstate Water Unit
Natural Resources and Environment Section
1525 Sherman Street, 5th Floor
Denver, CO 80203

Subject: State of Colorado's Response to Nebraska's "Expert Report on Accounting Issues: Haigler Canal and Groundwater Model Accounting Points"

This letter sets forth my opinions that were prepared at your request for the State of Colorado ("Colorado") based on my review of the report prepared for the State of Nebraska entitled "Expert Report on Accounting Issues: Haigler Canal and Groundwater Model Accounting Points" prepared by James C. Schneider, Ph.D. and James R. Williams, P.E. dated January 20, 2009 ("Nebraska Report"). The Nebraska Report proposes changes to the current compact accounting procedures to address the following two issues:

1. Haigler Canal – Net Diversions, Return Flows, and Virgin Water Supply
2. Groundwater Model Accounting Points – Frenchman Creek, North Fork Republican River, South Fork Republican River, and Driftwood Creek

Nebraska's proposed change to determine the "net diversions" for the Haigler Canal would decrease the computed beneficial consumptive use charged to Nebraska under the current approved accounting procedures. The net effect of Nebraska's other proposed changes would be to decrease Colorado's compact allocations and to increase Nebraska's compact allocations.

The current compact accounting procedures were approved by the three states in the Final Settlement Stipulation in *Kansas v. Nebraska and Colorado* and are documented in Appendix C of the Final Settlement Stipulation dated December 15, 2002. The accounting procedures were slightly revised on July 27, 2005, and adopted during the 2006 RRCA annual meeting.

My opinions and the basis for those opinions are set forth below in the same order as the Nebraska Report is organized.

Haigler Canal – Net Diversions

Nebraska proposes to change the procedure to determine the diversions by the Haigler Canal used to compute the beneficial consumptive use charged to Nebraska. The Haigler

Canal has historically diverted water from the North Fork of the Republican River in Colorado for irrigation of lands in Colorado and Nebraska and is specifically addressed in Article V of the Republican River Compact.

A measuring flume was installed where the Haigler Canal crosses the state line to account for the portion of the diversions from the North Fork of the Republican River in Colorado that are delivered for irrigation of lands in Nebraska. Currently, diversions by the Haigler Canal for use in Nebraska are based on the recorded flow measured at a measuring flume on the ditch at the state line. There is also a measuring flume near the end of the Haigler Canal to measure the amount of water that is returned by Nebraska into the Arikaree River. Nebraska proposes to subtract the amount of water returned to the Arikaree River from the flows recorded at the Haigler Canal state line measuring flume. Basically, Nebraska's proposal to determine Haigler Canal diversions can be summarized as follows:

Current Approved Accounting Procedures:

NE diversions for Haigler Canal = Haigler Canal Stateline gage

Nebraska's Proposed Accounting Procedures:

NE diversions for Haigler Canal = Haigler Canal Stateline gage minus Haigler Spillback gage.

Table 1 summarizes pertinent hydrologic data for the Haigler Canal and the effects of the change proposed by Nebraska. As shown in Table 1, the amount of water returned to the Arikaree River at the Haigler Canal wasteway is equal to 22% of the diversions measured at the stateline flume. I do not agree with Nebraska's proposal to subtract the amount returned to the Arikaree River at the Haigler Canal wasteway from the flows recorded at the measuring flume on the Haigler Ditch to determine the Nebraska Haigler Canal diversions.

The RRCA accounting procedures state that computed beneficial consumptive use from diversions by non-federal canals shall be 60 percent of the diversions and that the return flows shall be 40 percent of the diversions. The water returned to the Arikaree River at the Haigler Canal wasteway is part of the return flows that is accounted for by the provision that the return flow shall be 40 percent of the total diversions. Subtracting the water returned to the Arikaree River at the Haigler Canal wasteway from the flows recorded at the measuring flume on the Haigler Canal at the state line would result in underestimating the computed beneficial consumptive use that should be charged to Nebraska. If the amounts returned to the Arikaree River at the Haigler Canal wasteway were subtracted from the flows recorded at the measuring flume on the Haigler Canal at the state line, it would effectively be subtracting the returns twice.

In addition, a portion of the water returned at the Haigler Canal wasteway is the result of inflow to the Haigler Canal from rainfall runoff downstream of the measuring flume on the Haigler Canal at the state line. It would not be appropriate to subtract the amounts returned to the Arikaree River at the Haigler Canal wasteway from the flows recorded at the Haigler Canal stateline flume without accounting for rainfall runoff below the stateline flume.

In summary, in my opinion the change proposed by Nebraska is not appropriate for the following reasons:

1. Subsections IV.A.2.a of the RRCA accounting procedures states that:

“Computed Beneficial Consumptive Use from diversions by non-federal canals shall be 60 percent of the diversions; the return flow shall be 40 percent of diversion”.
2. Nebraska’s proposal would re-define the Nebraska Haigler Canal diversions to mean net diversions not total diversions. By subtracting the amounts returned to the Arikaree River at the Haigler Canal wasteway from the diversions measured at the measuring flume at the state line, Nebraska’s proposal would reduce the diversions that are used as the basis for determining Nebraska’s computed beneficial consumptive use and would effectively reduce the consumptive use percentage on the Nebraska Haigler Canal diversions from 60% to 47%.
3. Under the current RRCA accounting procedures return flows are 40% of diversions, which accounts for ditch and lateral seepage, deep percolation of applied water, surface water runoff (tailwater) from applied water, and water returned through wasteways. The water that is returned through the Haigler Canal wasteway is accounted for in the 40% factor.
4. A portion of the water measured at the Haigler Canal wasteway is the result of inflow to the Haigler Canal downstream of the Haigler Canal flume at the state line as the result of rainfall runoff. This inflow into the canal is not included in the flows recorded at the measuring flume on the Haigler Canal at the state line. Even if the procedure to determine computed beneficial consumptive use from diversions by non-federal canals were revised, it would not be appropriate to subtract the amounts returned to the Arikaree River from the flows recorded at the stateline flume without accounting for inflows from rainfall runoff between the two locations.

The current RRCA accounting procedures to determine diversions and computed beneficial consumptive use for the Haigler Canal diversions are appropriate and should not be changed.

Return Flows Associated with Haigler Canal

Nebraska proposes to subtract the return flows from the irrigation of lands irrigated by the Haigler Canal in Nebraska from the gaged flows of the Arikaree River. The net effect of Nebraska’s proposed change would be to reduce the virgin water supply in the Arikaree sub-basin and increase the virgin water supply in the Republican River Main Stem. Colorado is

allocated 78.5% of the Arikaree sub-basin virgin water supply and 0% of the Main Stem virgin water supply. Nebraska is allocated 16.8% of the Arikaree sub-basin virgin water supply and 48.9% of the Main Stem virgin water supply. Therefore, subtracting return flows from the irrigation of lands irrigated by the Haigler Canal in Nebraska from the gaged flows of the Arikaree River would have the effect of reducing Colorado's allocations and increasing Nebraska's allocations.

I do not agree with Nebraska's proposed change for the following reasons:

1. The Haigler Canal is irrigating the same basic service area in Nebraska today as it did when the compact was negotiated in 1942. Any return flows from the Haigler Canal lands that accrue to the Arikaree River today are the same as when the compact was negotiated. The allocations to the States in the compact were based on average annual virgin water supply estimates for designated drainage basins, including the Arikaree sub-basin.
2. Even if it was appropriate to subtract Haigler Canal return flows from the gaged streamflows of the Arikaree River to determine the virgin water supply of the Arikaree sub-basin, Nebraska's proposal significantly overstates the amount of Haigler Canal return flows included in the gaged streamflows of the Arikaree River. Nebraska's proposal assumes that "49% of these return flows [from the Haigler Canal] pass the Arikaree sub-basin gage". Nebraska provided no hydrologic analysis to support this hypothesis, and, in my opinion, this assumption is not reasonable.
3. Nebraska's proposal estimates that the Haigler Canal return flows that accrue to the Arikaree River sub-basin and flow through the Arikaree River streamflow gage for the 1995-2006 period averaged approximately 1.10 cfs $\{(5,170 - 1,117) \times 0.40 \times 0.49 / (1.9835 \times 365)\}$. In 2002, the Nebraska proposal estimates the return flows averaged 1.30 cfs.
4. One method of evaluating the portion of Haigler Canal return flows that reach the Arikaree River gage is to look at a year with low precipitation. In a year with low precipitation the amount of rainfall runoff from the Arikaree sub-basin would be relatively small, making it possible to inspect the streamflow data to see if any Haigler Canal return flows reach the Arikaree River gage as streamflow. Figure 1 presents a graph of the observed streamflow at the Arikaree River gage for 2002 versus Nebraska's proposed adjustment to the gaged flows. The precipitation in Wray, Colorado was 67% of normal in 2002.
5. As shown in Figure 1, the amount of irrigation return flow plus the Haigler Canal wasteway flows under the Nebraska proposal greatly exceeds the measured streamflow observed at the Arikaree River gage on most days. In fact in 2002 there were a total of 212 days when there was no streamflow at the Arikaree River gage. In

2005 the precipitation at Wray was 126% of average, but there were still 225 days when there was no streamflow at the Arikaree River gage.

6. Table 2 is a summary of Nebraska's proposed adjustments to the Arikaree River gage for the years 1995-2006. As shown in Table 2, since 2001 the proposed adjustments to the Arikaree River gaged flow exceed the total gaged streamflow which includes the rainfall runoff generated from the 1,700 square mile drainage basin upstream of the gage.
7. The vast majority of the irrigation return flows from the Haigler Canal recharge the groundwater system, as is evident from the relatively sandy soil under the Haigler Canal and inspection of the Arikaree River streamflow gage records.
8. The RRCA Groundwater Model indicates that the prevalent direction of groundwater flow under the Haigler Canal is to the north toward the Main Stem of the Republican River. The current RRCA accounting procedures correctly account for the Haigler Canal return flows as accruing to the Main Stem.
9. There are several wells located along the Arikaree River in Nebraska and under the Haigler Canal that intercept a portion of the Haigler Canal return flows.
10. Under the Haigler Canal in Nebraska, there are numerous center-pivot sprinklers that have been brought into operation since the compact was signed. These sprinkler irrigation systems use water more efficiently than flood irrigation. If an adjustment were to be made for Haigler Canal return flows, as Nebraska has proposed, then the percentages used to determine computed beneficial consumptive use and return flows from diversions would need to be revised. Paragraph IV.A.2.b of the RRCA Accounting Procedures in the Final Settlement Agreement provides that the consumptive use for Center Pivots is 83%. A typical maximum efficiency for flood irrigation is generally estimated to be approximately 65%.

In summary, Nebraska did not provide the hydrologic analysis to support the hypothesis that 49% of the Haigler Canal return flows are included in the Arikaree River gaged flows. The current approved accounting procedures are reasonable and appropriate to account for the Haigler Canal diversions and associated return flows.

Haigler Canal - Virgin Water Supply Calculations

Nebraska proposes to adjust the virgin water supply for the Arikaree River sub-basin by subtracting the Haigler Canal wasteway flows from the flows of the Arikaree River measured at the Arikaree streamflow gage, which is located approximately 2.5 miles downstream of the Haigler Canal wasteway. I do not agree with Nebraska's proposed change.

Haigler Canal wasteway return flows return to the Arikaree River today as they did when the compact was negotiated. The allocations to the States in the compact were based on average annual virgin water supply estimates for designated drainage basins. The average annual virgin water supply for the Arikaree sub-basin in the compact included any Haigler Canal wasteway flows that reached the Arikaree river gage.

Nebraska did not provide any hydrologic analysis to support its position that the Haigler Canal wasteway flows reach and are included in the flows of the Arikaree River measured at the streamflow gage. As demonstrated in the previous section, for most days, the majority of the Haigler Canal wasteway returns soak into the Arikaree River streambed and become groundwater that flows north toward the Main Stem. Therefore, it is not appropriate to subtract Haigler Canal wasteway flows from the streamflows measured at the Arikaree River gage to determine the virgin water supply for the Arikaree sub-basin.

Groundwater Model Accounting Points

Nebraska proposes to change the location of four groundwater model accounting points. The net effect of these changes would be to reduce the allocation of virgin water supply to Colorado and increase the allocation of virgin water supply to Nebraska. Changing the accounting points would not change any state's total computed beneficial consumptive use, but it would change the computed beneficial consumptive use charged to a state in certain sub-basins and would change the virgin water supply for certain sub-basins. I do not agree with Nebraska's proposed changes for the following reasons:

1. The compact makes allocations of the virgin water supply within specified designated drainage basins ("sub-basins"). Nebraska's proposal is to re-define a sub-basin as the portion of the sub-basin upstream of a stream gage, thereby excluding groundwater depletions and accretions that occur downstream from the stream gage, but upstream of the confluence of the sub-basin with the Main Stem.
2. Nebraska's proposal is contrary to the States' agreement that the values for each sub-basin includes all groundwater depletions and accretions upstream of the confluence with the Main Stem. Section III.A.2 of the RRCA Accounting Procedures states:

"Adjustments for flows diverted around Sub-basin stream gages and for Computed Beneficial Consumptive Uses in a Sub-basin between the Sub-basin stream gage and the confluence of the Sub-basin tributary and the Main Stem shall be made as described in Subsections III.D.1 and 2 and IV.B"

Section III.D.1 of the RRCA Accounting Procedures states:

"The values for each Sub-basin will include all depletions and accretions upstream of the confluence with the Main Stem. The values for the Main

Stem will include all depletions and accretions in stream reaches not otherwise accounted for in a Sub-basin.”

3. The streamflow gages in the Sub-basins are not located exactly at the confluence with the Main Stem due to hydraulic constraints. However, the groundwater model is capable of summarizing the total groundwater depletions and accretions in each sub-basin upstream of the confluence with the Main Stem. The current accounting points in the groundwater model accomplish this objective. The States agreed that the values for each sub-basin will include all groundwater depletions and accretions when the RRCA Accounting Procedures were developed and included as Appendix C to the Final Settlement Stipulation.

Table 3 and Table 4 summarize the effect on the virgin water supply if the accounting points are moved to the location proposed by Nebraska for the South Fork and North Fork, respectively. Table 5 summarizes the impact on Colorado’s virgin water supply allocation as the result of all of the changes proposed by Nebraska.

Summary

This letter states my professional opinions based on my review of the expert report prepared for the State of Nebraska. Table 6 lists the documents and information I relied upon.

First, I do not agree with Nebraska’s proposal to subtract the Haigler Canal wasteway returns to the Arikaree River from the flows recorded at the measuring flume on the Haigler Ditch at the state line to determine the diversions for the lands irrigated by the Haigler Canal in Nebraska. The current RRCA accounting procedures reasonably account for the computed beneficial consumptive use of diversions for the lands irrigated by the Haigler Canal in Nebraska, and no change should be made to the current RRCA accounting procedures.

Second, I do not agree with Nebraska’s proposal to subtract Haigler Canal return flows from the gaged flows of the Arikaree River to determine the virgin water supply of the Arikaree sub-basin. Inspection of the Arikaree River gage records demonstrate that these return flows are not included in the Arikaree Gage flows. Therefore, Haigler Canal return flows should not be subtracted from the gaged flows of the Arikaree River to determine the virgin water supply of the Arikaree sub-basin.

Third, I do not agree that the Haigler Canal wasteway flows should be subtracted from the Arikaree River Gage to compute the virgin water supply for the Arikaree sub-basin. The majority of the Haigler Canal wasteway returns soaks into the Arikaree River streambed and become groundwater that flows north toward the Main Stem. Wasteway return flows from the Haigler Canal lands accrue to the Arikaree River today as they did when the compact was negotiated, and the average annual virgin water supply for the Arikaree sub-basin in the compact included some wasteway return flows.

Fourth, I do not agree with Nebraska's proposal to change the location of four groundwater model accounting points because it is contrary to the States' agreement that the values for each sub-basin will include all groundwater depletions and accretions upstream of the confluence with the Main Stem. The groundwater model accounting points used in the current procedures are in the correct location to calculate the virgin water supply for each sub-basin.

Slattery Aqua Engineering LLC



James E. Slattery, P.E.

Table 1
Haigler Canal Wasteway

Row	Description	1995-2006 Average (ac-ft)
1	Haigler Canal diversions measured at the Stateline Flume	5,170
2	Measured Haigler Canal Wasteway Flume at the Arikaree River	1,117
3	Nebraska's proposed net Haigler Canal diversion (calculated as Row 1 minus Row 2)	4,053
4	Amount of Computed Beneficial Consumptive Use charged to Nebraska under current approved accounting methodology (0.6x Row 1)	3,102
5	Amount of Computed Beneficial Consumptive Use charged to Nebraska under Nebraska's proposed methodology (0.6 x Row 3)	2,432
6	Decrease in Nebraska's Computed Beneficial Consumptive Use as the result of Nebraska's proposed change (Row 4 – Row 5)	670
7	Haigler Canal Wasteway as a percentage of Diversions Row 2/Row 1	22%
8	Computed Beneficial Consumptive Use as a percentage of Canal Diversions under Nebraska's Proposal (Row 5 / Row 1)	47%

Source: Table 1 of Nebraska's January 20, 2009 Report

Table 2
Summary of Nebraska's Proposed Adjustments to the Arikaree River Gage
(units of ac-ft)

Year (1)	NE Proposed				Total Proposed Adjustment to the Arikaree River Gaged Flows (6)	Adjusted Arikaree River Gaged Flows Proposed by Nebraska (7)	Change in Arikaree Virgin Flow Allocation		
	Arikaree Streamflow (2)	Haigler Canal at Stateline Flume (3)	NE Proposed Adjustment for Haigler Return Flows to the Arikaree Basin (4)	NE Proposed Adjustment for Spillback flow from Haigler Canal to the Arikaree Basin (5)			Colorado (8)	Kansas (9)	Nebraska (10)
1995	6,440	3,837	652	509	1,161	5,279	-911	-59	-195
1996	5,667	5,351	669	1,938	2,607	3,060	-2,046	-133	-438
1997	2,948	4,917	744	1,119	1,863	1,085	-1,462	-95	-313
1998	2,700	6,553	971	1,601	2,572	128	-2,019	-131	-432
1999	6,803	6,458	746	2,650	3,396	3,407	-2,666	-173	-571
2000	3,629	5,847	1,051	488	1,539	2,090	-1,208	-78	-259
2001	552	5,447	988	406	1,394	-842	-1,094	-71	-234
2002	231	5,092	941	289	1,230	-999	-966	-63	-207
2003	1,060	5,763	802	1,670	2,472	-1,412	-1,941	-126	-415
2004	341	3,703	597	655	1,252	-911	-983	-64	-210
2005	1,151	4,107	543	1,338	1,881	-730	-1,477	-96	-316
2006	404	4,961	827	741	1,568	-1,164	-1,231	-80	-263
Avg	2,661	5,170	794	1,117	1,911	749	-1,500	-97	-321

Explanation of Columns

Data in Columns 3 and 4 from Table 2 of the Nebraska January 20, 2009 Report

- (1) Calendar Year
- (2) Gaged flows for the Arikaree River at Haigler, NE USGS streamflow gage
- (3) Values from Table 2 of the Nebraska January 20, 2009 Report
- (4) Values from Table 2 of the Nebraska January 20, 2009 Report
- (5) Values from Table 2 of the Nebraska January 20, 2009 Report
- (6) Calculated as Col 4 + Col 5
- (7) Calculated as Col 2 - Col 6
- (8) Calculated as the Percent Allocation for the State x Column 6
- (9) Calculated as the Percent Allocation for the State x Column 6
- (10) Calculated as the Percent Allocation for the State x Column 6

Table 3

South Fork Accounting Points

(GW CBCU is Computed Beneficial Use of groundwater calculated using RRCA Groundwater Model, values in ac-ft)

Approved Method of Accounting				
Year	CO GW	KS GW	NE GW	Total
(1)	CBCU	CBCU	CBCU	(5)
(1)	(2)	(3)	(4)	(5)
1993	9,498	8,380	806	18,684
1994	8,999	3,326	603	12,928
1995	12,038	8,932	889	21,859
1996	11,006	7,547	934	19,487
1997	9,123	5,912	853	15,888
1998	11,280	7,752	805	19,837
1999	12,430	8,865	1,048	22,343
2000	9,280	6,320	982	16,582
2001	9,748	7,450	641	17,839
2002	9,498	4,892	1,282	15,672
2003	10,790	5,351	1,347	17,488
2004	11,532	5,781	1,202	18,515
2005	13,679	7,227	1,372	22,278
2006	10,495	4,398	1,040	15,933
2007	11,240	5,527	1,055	17,822
Avg	10,709	6,511	991	18,210

NE Proposed Method of Accounting				
Year	CO GW	KS GW	NE GW	Total
(1)	CBCU	CBCU	CBCU	(5)
(1)	(2)	(3)	(4)	(5)
1993	9,317	8,351	20	17,688
1994	8,702	3,842	14	12,558
1995	11,863	9,524	16	21,403
1996	10,772	7,732	17	18,521
1997	8,952	6,359	18	15,329
1998	11,199	8,533	14	19,746
1999	12,305	9,412	24	21,741
2000	9,015	6,813	20	15,848
2001	10,170	9,256	0	19,426
2002	9,485	5,118	33	14,636
2003	10,930	6,322	33	17,285
2004	11,474	6,229	32	17,735
2005	13,494	7,355	39	20,888
2006	10,083	4,479	31	14,593
2007	11,009	5,687	33	16,729
Avg	10,585	7,001	23	17,608

Difference (Proposed - Approved)				
Year	CO GW	KS GW	NE GW	Total
(1)	CBCU	CBCU	CBCU	(5)
(1)	(2)	(3)	(4)	(5)
1993	-181	-29	-786	-996
1994	-297	516	-589	-370
1995	-175	592	-873	-456
1996	-234	185	-917	-966
1997	-171	447	-835	-559
1998	-81	781	-791	-91
1999	-125	547	-1,024	-602
2000	-265	493	-962	-734
2001	422	1,806	-641	1,587
2002	-13	226	-1,249	-1,036
2003	140	971	-1,314	-203
2004	-58	448	-1,170	-780
2005	-185	128	-1,333	-1,390
2006	-412	81	-1,009	-1,340
2007	-231	160	-1,022	-1,093
Avg	-124	490	-968	-602

Change in South Fork Virgin Flow Allocation				
Year	CO	KS	NE	Total
(1)	(2)	(3)	(4)	(5)
1993	-442	-400	-14	-857
1994	-164	-149	-5	-318
1995	-202	-183	-6	-392
1996	-429	-388	-14	-831
1997	-248	-225	-8	-481
1998	-40	-37	-1	-78
1999	-267	-242	-8	-518
2000	-326	-295	-10	-631
2001	705	638	22	1,365
2002	-460	-416	-15	-891
2003	-90	-82	-3	-175
2004	-346	-314	-11	-671
2005	-617	-559	-19	-1,195
2006	-595	-539	-19	-1,152
2007	-485	-439	-15	-940
Avg	-267	-242	-8	-518

A negative number is a decrease in virgin water supply allocation.

Table 4

North Fork Accounting Points

(GW CBCU is Computed Beneficial Use of groundwater calculated using RRCA Groundwater Model, values in ac-ft)

Approved Method of Accounting				
Year	CO GW	KS GW	NE GW	Total
(1)	CBCU (2)	CBCU (3)	CBCU (4)	(5)
1993	11,400	0	693	12,093
1994	11,607	0	792	12,399
1995	12,011	12	848	12,871
1996	12,257	16	860	13,133
1997	12,307	14	970	13,291
1998	12,521	12	1,045	13,578
1999	13,004	15	1,030	14,049
2000	13,173	15	1,156	14,344
2001	13,534	18	1,676	15,228
2002	13,562	14	1,936	15,512
2003	14,023	17	1,402	15,442
2004	14,373	16	1,446	15,835
2005	14,359	17	1,443	15,819
2006	14,301	12	1,366	15,679
2007	14,762	14	1,422	16,198
Avg	13,146	13	1,206	14,365

NE Proposed Method of Accounting				
Year	CO GW	KS GW	NE GW	Total
(1)	CBCU (2)	CBCU (3)	CBCU (4)	(5)
1993	11,472	0	406	11,878
1994	11,691	0	427	12,118
1995	12,069	0	455	12,524
1996	12,311	0	487	12,798
1997	12,368	0	513	12,881
1998	12,598	0	544	13,142
1999	13,078	0	582	13,660
2000	13,245	0	616	13,861
2001	13,602	0	659	14,261
2002	13,657	0	700	14,357
2003	14,110	0	753	14,863
2004	14,436	0	798	15,234
2005	14,409	0	836	15,245
2006	14,369	0	866	15,235
2007	14,790	0	899	15,689
Avg	13,214	0	636	13,850

Difference (Proposed - Approved)				
Year	CO GW	KS GW	NE GW	Total
(1)	CBCU (2)	CBCU (3)	CBCU (4)	(5)
1993	72	0	-287	-215
1994	84	0	-365	-281
1995	58	-12	-393	-347
1996	54	-16	-373	-335
1997	61	-14	-457	-410
1998	77	-12	-501	-436
1999	74	-15	-448	-389
2000	72	-15	-540	-483
2001	68	-18	-1,017	-967
2002	95	-14	-1,236	-1,155
2003	87	-17	-649	-579
2004	63	-16	-648	-601
2005	50	-17	-607	-574
2006	68	-12	-500	-444
2007	28	-14	-523	-509
Avg	67	-13	-570	-515

Allocation 22.4% 0.0% 24.6%

Change in North Fork Virgin Flow Allocation

Year	CO	KS	NE	Total
(1)	(2)	(3)	(4)	(5)
1993	-48	0	-53	-101
1994	-63	0	-69	-132
1995	-78	0	-85	-163
1996	-75	0	-82	-157
1997	-92	0	-101	-193
1998	-98	0	-107	-205
1999	-87	0	-96	-183
2000	-108	0	-119	-227
2001	-217	0	-238	-454
2002	-259	0	-284	-543
2003	-130	0	-142	-272
2004	-135	0	-148	-282
2005	-129	0	-141	-270
2006	-99	0	-109	-209
2007	-114	0	-125	-239
Avg	-115	0	-127	-242

A negative number is a decrease in virgin water supply allocation.

Table 5
Summary of Effects of Nebraska's Proposed Changes on Colorado's Compact Allocation

Row	Description	1995-2006 Average (ac-ft)
1	Nebraska's Proposed Adjustment to Arikaree River Basin virgin flows due to Haigler Canal Wasteway flows and the accounting of Haigler Canal Return Flows (see Table 2)	-1,500
2	Nebraska's Proposed Change in Accounting Point for the South Fork (see Table 3)	-267
3	Nebraska's Proposed Change in Accounting Point for the North Fork (see Table 4)	-115
4	Total	-1,882

Note, a negative number is a decrease in Colorado's Compact Allocation.

Table 6
Documents and Information Relied Upon

(1)	Report prepared by James C. Schneider, Ph.D. and James R. Williams dated January 20, 2009 entitled "Expert Report on Accounting Issues: Haigler Canal and Groundwater Model Accounting Points" .
(2)	USGS streamflow records for the Arikaree River at Haigler, NE (068215000)
(3)	Daily flows for the Haigler Canal wasteway (Station ID 0061500). See website http://dnrdata.dnr.ne.gov/Canal/ .
(4)	Daily flows for the Haigler Canal Stateline flume (Station ID 61400). See website http://dnrdata.dnr.ne.gov/Canal/ .
(5)	Precipitation records for the Wray Climate Station (NOAA Wray 2E station).
(6)	Final Settlement Stipulation dated December 15, 2002 in the Supreme Court of the United States, State Of Kansas v. State of Nebraska and State of Colorado, No. 126, Original. Includes the attached Appendices A-J.
(7)	June 17, 2005 Aerial photographs of the NE Haigler Canal area as viewed on Google Earth website.
(8)	1960-1998 RRCA Annual Reports including attachments from Engineering Committee.
(9)	Paper prepared by Keith Vanderhorst, Colorado Division of Water Resources, titled "A Summary on Investigations of the Original Virgin Water Supply and Allocations of the Republican River Compact", dated December 13, 1989.
(10)	Participation in the development of the RRCA Groundwater Model in 2002 and 2003 on behalf of the State of Colorado including working with experts from Nebraska and Kansas to develop procedures to incorporate the results of the groundwater model into the compact accounting.
(11)	My educational training and my 23 years of professional engineering experience in addressing water resource issues.

Figure 1
2002 Arikaree River at Haigler Gage vs. Haigler Canal Returns Flow Claimed by Nebraska to be included in the Arikaree Gage

