Non-Binding Arbitration initiated May 2, 2013

Pursuant to

Decree of May 19, 2003, 538 U.S. 720

Kansas v. Nebraska & Colorado

No. 126 Orig., U.S. Supreme Court

Report on the Colorado Bonny Reservoir Accounting Proposal

Republican River Compact

Response to Application Submitted by Colorado, dated April 5, 2013

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1.0. Introduction

Colorado has submitted a proposal for modifying the representation of Bonny Reservoir with the RRCA Groundwater Model. (GW Model) The purpose of the modification is to represent the reservoir under changed operations, with the reservoir being managed as a "run of the river" structure. Colorado's stated intention is to regulate Bonny Reservoir such that streamflow will be passed through the reservoir as possible, subject to the capacity of the outlet works at the dam. The proposed change to the modeling is to set up a test based on reservoir content, whereby inflows are passed through to the downstream reach if water is not being stored, but is intercepted and not passed if water is being stored in the reservoir. The effect of the change is a significant reduction to the Colorado groundwater pumping depletions computed by the model. In addition, Colorado anticipates that the reservoir evaporation would be effectively eliminated.

The change was submitted by Colorado to the RRCA for consideration on April 5, 2013 and subsequently voted upon by the administration on May 2. Arbitration was invoked on May 2 for the proposal submitted to the Administration in April.

I have reviewed the request submitted by Colorado and the changes to the modeling results created by the change. I have consulted with David Barfield and Steve Larson in the review of the proposal. This report provides my conclusions and opinions regarding this proposal.

2.0. Description

The request by Colorado has been caused by the administrative action taken by the State of Colorado to assist with compact compliance in the Republican River Basin, by eliminating storage in Bonny Reservoir to the extent possible with the existing outlet works. This produces a reduction in consumptive use by reducing or eliminating reservoir evaporation. The reservoir also contributes to GW pumping depletions in Colorado and is modeled at the stage corresponding to the water level surface. Removing the reservoir storage therefore results in some reduction of pumping depletions in the vicinity of the reservoir.

Bonny Reservoir was constructed as a federal reservoir project in approximately 1950 and has been managed by the State of Colorado as a recreational facility. Since approximately 1996, storage has been declining due to lack of stream inflow and in 2011, Colorado began to release water remaining in storage. The reservoir storage has since been evacuated.

Bonny Reservoir is located on the South Fork of the Republican River in Colorado, approximately 10 miles west of the Colorado – Kansas Stateline. From the Reservoir it is approximately 54 stream miles to the Republican River at Benkelman, Nebraska. (See Figure 1). This is one of seven reservoirs included in the RRCA Groundwater Model.

The proposal requests a change to the representation of the reservoir in the GW Model. Essentially the change would be to remove the reservoir from the stream system in the model under most, if not all, conditions. There are two important elements involved for modeling the

reservoirs; the water level and interception of baseflow. The water level stage is specified in the model for each stress period. Model base inflows are intercepted and not passed downstream. The change proposed is to pass the base inflows at the reservoir site downstream.

The details of the change are described in more detail in the report prepared by Larson and Perkins.

The change has been determined to cause a large reduction on the calculated depletions for Colorado Groundwater pumping. The reasons for this are described in more detail below and in the Larson and Perkins report. Effects have been determined for the historical years of 2003 – 2008 and for a projected period of 40 years, using historical hydrology and pumping.

The total pumping depletions for Colorado would be reduced by 60%, from approximately 14,000 ac-ft/yr to 5,700 ac-ft/yr. A smaller reduction to the Kansas pumping depletion would also result, from 5,700 to 3,100 acre-feet/yr., or 45%. Kansas GW depletions are less than the Kansas allocation in the South Fork sub-basin. Historical ('03 – '08) average indicates Kansas CBCU 5,900 acre-feet/yr. with an allocation of 9,500 acre-feet/yr, or 3,600 acre-feet/yr. of unused allocation.

3.0 Modeling Results

The changes to the representation of the Bonny Reservoir with the Model have the effect of passing the base inflow through the reservoir to the downstream reach. This results in a significant change in the computed pumping depletions for Colorado. It also has some effect on the pumping depletions computed for the states of Kansas and Nebraska.

Table 1 is a compilation of the allocation, CBCU and balance from the sub-basin non-impairment test for Colorado for the years 2003 – 2008. The historical and projected results for the No-Bonny condition are included. The CBCU for Bonny Reservoir evaporation has been set to zero in the No-Bonny condition. The GW CBCU using the Colorado proposal changes from 12,850 acre-feet/yr. to 5,240 acre-feet/yr. This table includes revised allocations for the No-Bonny condition. This calculation required an assumption about the impact that eliminating the reservoir evaporation would have on the historical Benkelman streamflow. For purposes of this calculation, it was assumed that 50% of the evaporation removed from Table A would translate to the Benkelman gage. The resulting allocation with the revised GW CBCU and reservoir evaporation would be calculated as 5,080 acre-feet/yr.

Table 1 shows the Colorado balance with the sub-basin non-impairment test changes from a shortfall of -2,300 acre-feet/yr. to positive 1,120 acre-feet/yr. for this period.

Table 2 shows the Kansas allocation, CBCU and balance with the sub-basin non-impairment test for the years 2003 – 2008. The amount of allocation in excess of CBCU with the current modeling procedure was 3,640 acre-feet/yr. This is unused allocation for Kansas on the South

Fork. With the changed computation of CBCU, the unused allocation is reduced to 1,300 acre-feet/yr., or approximately 35% of the amount of unused allocation with Bonny Reservoir as currently modeled.

The effects of the change in CBCU and allocation for the South Fork for Colorado and Kansas accounting are shown on Figure 2.

Table 3 is a summary of the accounting for the Kansas Water Short Year Test. This test (Table 5B of the Accounting Procedures) is a two-year test for Northwest Kansas. The accounting is summarized for the years 2003 – 2007, which were water short years for compact accounting purposes. The Test shows that the NW Kansas balance (Total allocation – CBCU) ranged from 6,010 acre-feet to 7,500 acre-feet. With the changes proposed by Colorado the Kansas water-short year test balance is reduced to 2,330 to 4,660 acre-feet.

The proposed change to pass the inflows at the reservoir to the downstream reach results in baseflow passing downstream in the No-Colorado pumping condition, but not in any significant amount in the historical pumping condition, since the baseflow has been largely eliminated upstream of Bonny Reservoir. Therefore, the no-pumping baseflow is subject to significant reduction between Bonny Reservoir and Benkelman, resulting in a reduction in computed GW CBCU. This effect is the same as that which occurs downstream of Colorado on the mainstem of the Republican River above Swanson Reservoir, where negative depletions are compiled and netted out against Colorado's pumping depletions.

As noted in the Larson and Perkins report, the pumping impacts on the South Fork, when calculated separately for each of the three states with the Colorado proposal, results in a total pumping effect that is less than the pumping impacts determined when all pumping is considered simultaneously. This is described as the residual CBCU not allocated and represents a deviation from the no-pumping condition at Benkelman.

4.0 Summary and Conclusions

The change proposed by Colorado would reduce Colorado GW CBCU on the South Fork from 14,300 to 5,700 acre-feet/yr. for a projected future condition. This is allocated as 3,100 acre-feet/yr at the reservoir due to the changed water level conditions, 3,200 ac-ft/yr downstream in Kansas and the balance downstream of the reservoir in Colorado.

The Colorado balance between the CBCU and allocation on the South Fork would be improved from -5,620 to -480 acre-feet/yr. for the 2003 – 2008 period. When adding the unallocated supply for the sub-basin non-impairment test, CBCU would be less than the available supply.

Kansas unused allocation on the South Fork (allocation – CBCU) would be reduced by 65% or 2,340 acre-feet/yr as a result of the change proposed by Colorado to represent Bonny Reservoir for computing Groundwater pumping depletions in Colorado.

A portion of the change in the Colorado Groundwater pumping depletion computed with the proposed change, 38%, occurs downstream of the Stateline. Changes to pumping depletions computed downstream of Bonny Reservoir are attributed to changing the assumption being made for passing the baseflow past the reservoir in the no-pumping condition.

The change in computing pumping impacts for the Colorado proposal has significantly increased the amount of unallocated pumping depletion for the South Fork, to 3,800 acre-feet/yr. for the projected pumping and precipitation condition.

TABLES

Table 1
Colorado South Fork Sub-Basin
Allocation, Computed Beneficial Consumptive Use (CBCU), and Compliance Status
2003 - 2008
(acre-feet)

A. Historical

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	Allocation	Ground Water	CBCU Bonny Evaporation	Total	Allocation - CBCU	Unallocated Supply	Total Available Supply	Available Supply - CBCU
2003	10,540	12,115	3,375	16,090	(5,550)	3,320	13,860	(2,230)
2004	10,690	12,874	3,158	16,800	(6,110)	3,370	14,060	(2,740)
2005	12,230	14,952	3,430	18,660	(6,430)	3,860	16,090	(2,570)
2006	9,120	11,756	3,031	14,790	(5,670)	2,880	12,000	(2,790)
2007	10,160	12,511	2,716	15,490	(5,330)	3,200	13,360	(2,130)
2008	10,320	12,892	1,980	14,920	(4,600)	3,250	13,570	(1,350)
Average	10,510	12,850	2,950	16,130	(5,620)	3,310	13,820	(2,300)

B. No Bonny (9)

Year	Allocation	Ground Water	CBCU Bonny Evaporation	Total	Allocation - CBCU	Unallocated Supply	Total Available Supply	Available Supply - CBCU
2003	3,560	2,636	0	3,230	330	1,120	4,680	1,450
2004	3,620	2,783	0	3,550	70	1,140	4,760	1,210
2005	5,870	6,177	0	6,450	(580)	1,850	7,720	1,270
2006	5,070	5,980	0	5,980	(910)	1,600	6,670	690
2007	5,940	6,687	0	6,950	(1,010)	1,870	7,810	860
2008	6,430	7,182	0	7,230	(800)	2,030	8,460	1,230
Average	5,080	5,240	0	5,570	(480)	1,600	6,680	1,120

(1) Colorado's allocation on the South Fork, equal to 44.4% of the Computed Water Supply.
(2) Colorado's ground water cbcu computed using the RRCA Ground Water Model.
(3) Bonny Reservoir evaporation.
(4) Total CBCU equals the ground water CBCU plus surface water CBCU, rounded to the nearest ten acre-feet. Colorado had 327 acre-feet/year of surface water CBCU in addition to Bonny evaporation.
(5) equals (1) - (4)
(6) Unallocated supply equals 14% of the Computed Water Supply.
(7) equals (1) + (6)
(8) equals (7) - (4)
(9) No Bonny condition incorporates results from the RRCA Ground Water without Bonny, assumes zero Bonny evaporation with 50% effect at Benkelman gage, and zero change in storage without modification to the gage.

Table 2

Kansas South Fork Sub-Basin

Allocation, Computed Beneficial Consumptive Use (CBCU), and Compliance Status

2003 - 2008

(acre-feet)

A. Historical

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		CBCU						
Year	Allocation	Ground Water	Surface Water	Total	Allocation - CBCU	Unallocated Supply	Total Available Supply	Available Supply - CBCU
2003	9,540	5,351	29	5,380	4,160	3,320	12,860	7,480
2004	9,680	5,781	303	6,080	3,600	3,370	13,050	6,970
2005	11,080	7,227	294	7,520	3,560	3,860	14,940	7,420
2006	8,260	4,398	325	4,720	3,540	2,880	11,140	6,420
2007	9,200	5,527	144	5,670	3,530	3,200	12,400	6,730
2008	9,340	5,748	121	5,870	3,470	3,250	12,590	6,720
Average	9,520	5,670	200	5,870	3,640	3,310	12,830	6,960

B. No Bonny (9)

		CBCU						
Year	Allocation	Ground Water	Surface Water	Total	Allocation - CBCU	Unallocated Supply	Total Available Supply	Available Supply - CBCU
2003	3,220	1,395	29	1,420	1,800	1,120	4,340	2,920
2004	3,280	2,095	303	2,400	880	1,140	4,420	2,020
2005	5,310	4,184	294	4,480	830	1,850	7,160	2,680
2006	4,590	3,080	325	3,400	1,190	1,600	6,190	2,790
2007	5,370	3,690	144	3,830	1,540	1,870	7,240	3,410
2008	5,820	4,137	121	4,260	1,560	2,030	7,850	3,590
Average	4,600	3,100	200	3,300	1,300	1,600	6,200	2,900

(1) Kansas' allocation on the South Fork, equal to 40.2% of the Computed Water Supply.
(2) Kansas' ground water cbcu computed using the RRCA Ground Water Model.
(3) Total of small pumps and non-Federal reservoir evaporation CBCU.
(4) equals (2) plus (3), rounded to the nearest ten acre-feet.
(5) equals (1) - (4)
(6) Unallocated supply equals 14% of the Computed Water Supply.
(7) equals (1) + (6)
(8) equals (7) - (4)
(9) No Bonny condition incorporates results from the RRCA Ground Water without Bonny, assumes zero Bonny evaporation with 50% effect at Benkelman gage, and zero change in storage without modification to the gage.

Table 3

Table 5B of the Accounting Procedures
Kansas Water Short Year Test
Historical and Without Bonny Reservoir
2003 - 2007
(acre-feet)

Table 5B: Kansas Compliance During Water-Short Year Administration - Historical

Year	Allocation			Computed Beneficial Consumptive Use	Imported Water Supply Credit	Allocation - (CBCU - IWS)	**Two-Year Avg. [2] WSY Test**
	Sub-Basin Total	Kansas's Share [1] of Unallocated Supply	Total				
2003	13,900	4,527	18,427	12,130	NA	6,297	
2004	13,060	3,976	17,036	11,320	NA	5,716	**6,010**
2005	18,380	6,060	24,440	16,370	NA	8,070	**6,890**
2006	14,750	4,589	19,339	14,630	NA	4,709	**6,390**
2007	23,060	7,849	30,909	20,610	NA	10,299	**7,500**

Table 5B: Kansas Compliance During Water-Short Year Administration - No Bonny [3]

Year	Allocation			Computed Beneficial Consumptive Use	Imported Water Supply Credit	Allocation - (CBCU - IWS)	**Two-Year Avg. [2] WSY Test**
	Sub-Basin Total	Kansas's Share [1] of Unallocated Supply	Total				
2003	7,580	3,403	10,983	8,170	NA	2,813	
2004	6,660	2,836	9,496	7,640	NA	1,856	**2,330**
2005	12,610	5,038	17,648	13,330	NA	4,318	**3,090**
2006	11,080	3,935	15,015	13,310	NA	1,705	**3,010**
2007	19,230	7,164	26,394	18,770	NA	7,624	**4,660**

Notes:

(1) Kansas receives 51.1% of the unallocated supply.

(2) Table 5B is a two-year test. This was added by Kansas to show the two-year running average for the five years in the table.

(3) No Bonny condition incorporates results from the RRCA Ground Water without Bonny, assumes zero Bonny evaporation with 50% effect at Benkelman gage, and zero change in storage without modification to the gage.

FIGURES

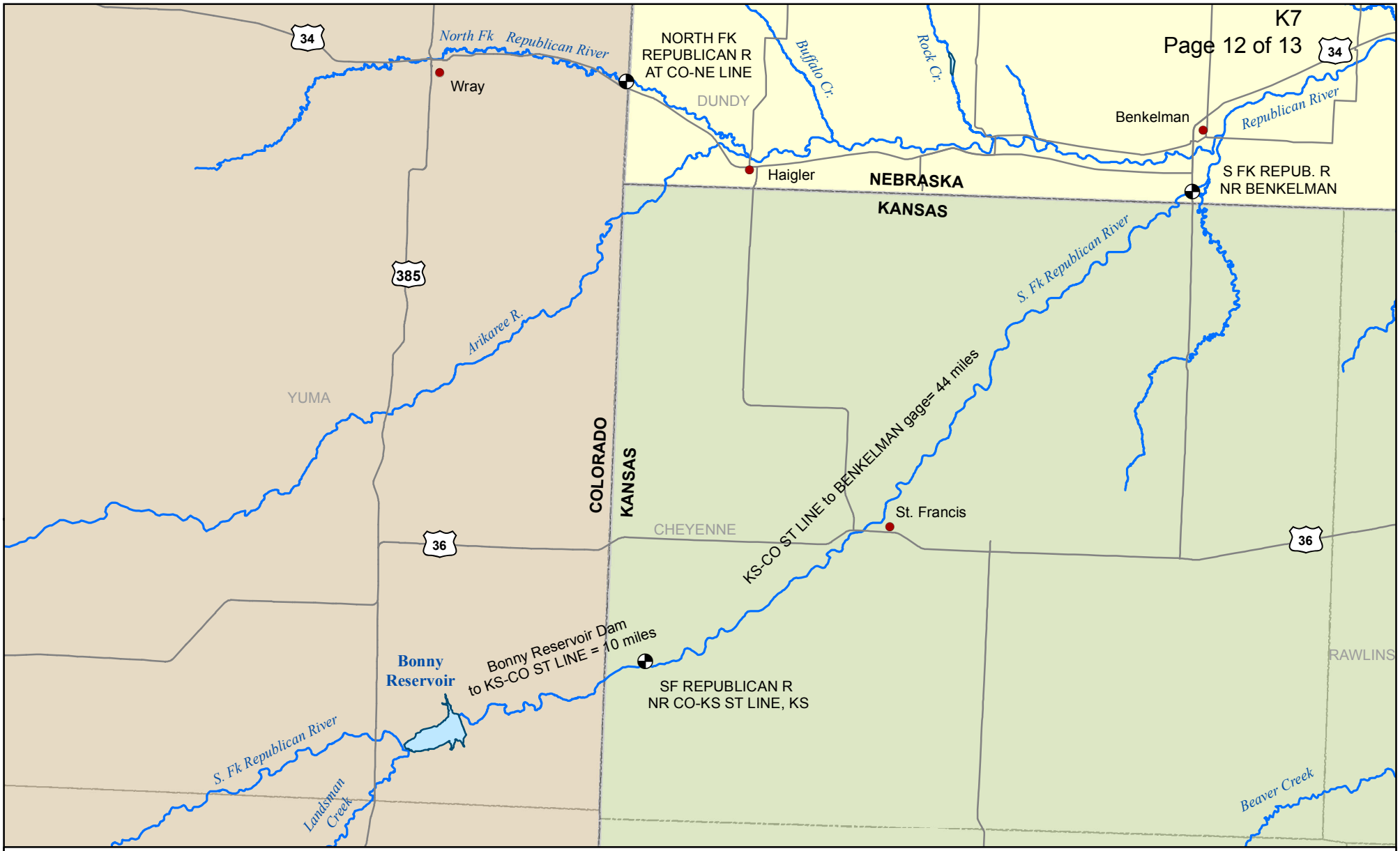

FIGURE 1

General Location Map
South Fork of the Republican River

5 2.5 0 5 10 Miles

Approximate Scale = 1:400,000

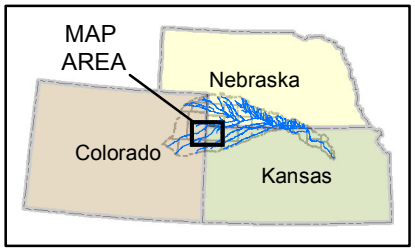

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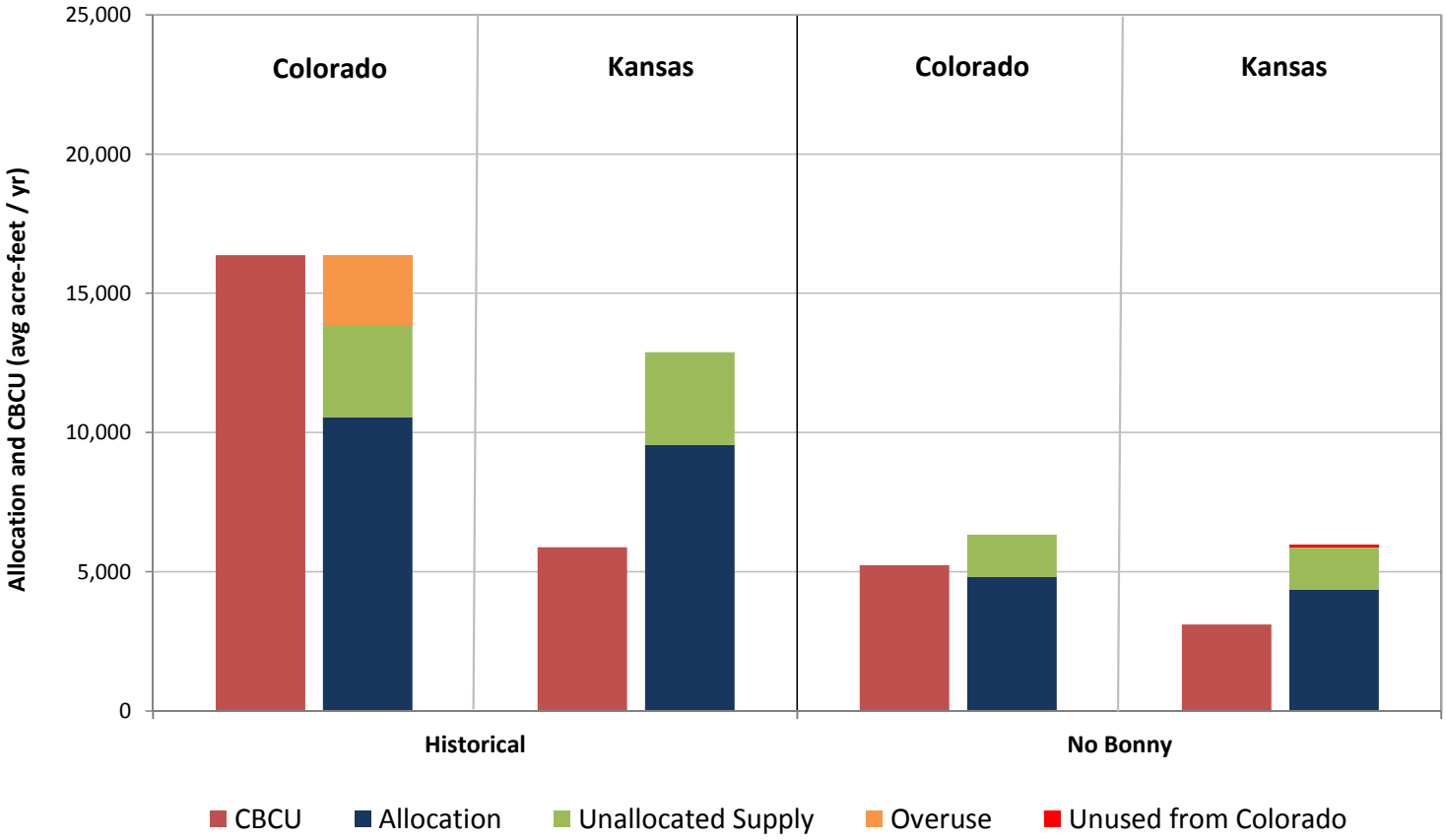
Figure 2
South Fork of the Republican River
Comparison of CBCU and Available Supply for Colorado and Kansas
2003 - 2007
average acre-feet / yr



Notes:
(1) Unallocated supply equals 14% of the Computed Water Supply. Colorado has access to the unallocated if they are in compliance with their Statewide test.
(2) Overuse equals the maxiumum of the Available Supply minus CBCU or zero.
(3) Kansas is allowed access to the unused portion of Colorado's allocation. It is equal to the maximum of Colorado's allocation less CBCU or zero.
(4) No Bonny condition incorporates results from the RRCA Ground Water without Bonny, assumes zero Bonny evaporation with 50% effect at Benkelman gage, and zero change in storage without modification to the gage.