KANSAS
DEPARTMENT OF AGRICULTURE

Kathleen Sebelius, Governor
Adrian J. Polansky, Secretary

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December 19, 2007

Ann Bleed, P.E.
Nebraska Commissioner,
Republican River Compact Administration
Director, Nebraska Department of Natural Resources
P.O. Box 94676
Lincoln, NE 68509-4676

Subject: Remedy for Nebraska's violation of the Decree in *Kansas v. Nebraska & Colorado,* No. 126, Original, U.S. Supreme Court

Dear Commissioner Bleed:

The State of Nebraska is in violation of the May 19, 2003 Supreme Court Decree in *Kansas v. Nebraska & Colorado,* 538 U.S. 720 (2003). The Decree approved the Final Settlement Stipulation ("FSS"), which had been filed with the Special Master on December 16, 2002. The FSS requires compliance on a five-year running average, and, when Water-Short Year Administration is in effect, compliance is also calculated on a two-year running average unless Nebraska submits an Alternative Water-Short Year Administration plan to the Republican River Compact Administration ("RRCA"). Appendix B to the FSS provides the FSS Implementation Schedule, which sets the first normal compliance year as 2007 (5-year running average for 2003-2007) and the first Water-Short Year Administration compliance year as 2006 (2-year running average for 2005-2006) if water supply conditions for Water-Short Year Administration are present.

Pursuant to the Implementation Schedule and water supply conditions, Water-Short Year Administration began in 2006. Data for the year 2006 was received in 2007. Analysis of that data and data for 2005 shows the 2-year running average of Nebraska's Computed Beneficial Consumptive Use above Guide Rock for 2005-2006 to be 41,430 acre-feet per year in excess of Nebraska's allocations above Guide Rock, contrary to Subsection V.B.2 (a) of the FSS. For the two years, Nebraska's total overuse of water in violation of the FSS amounts to 82,870 acre-feet. See Attachment 1 hereto. For comparison, this amount is more than a city in Kansas of 100,000 population consumes in 10 years. It is also more than twice the amount of water that would be consumed per year under full supply conditions on all the acreage authorized to be irrigated in the Kansas Bostwick Irrigation District in the Republican Basin.

Kansas began to express its concerns in the 1980s that Nebraska was violating the Compact. Despite continued complaints by Kansas and attempts at mediation, Nebraska allowed further significant increases in water development and use by its water users. Consequently, Kansas was forced to file *Kansas v. Nebraska & Colorado,* No.126, Orig., in 1998. After rulings by the Special Master and the Supreme Court, the States agreed to the FSS in December 2002 as noted above. Since then Kansas has complied with all of its obligations under the FSS in good

faith. The State of Nebraska, on the other hand, has seriously neglected its obligations under the FSS. Actions by the State of Nebraska have been grossly insufficient and unrealistic, resulting in injury to Kansas and its water users. As was the case when David Pope wrote his letter of January 24, 2007, actions apparently being discussed by the State of Nebraska will continue to be insufficient and ignore growing river depletions due to past groundwater pumping.

It is now five years since the FSS was agreed to by Nebraska. But again, the State of Nebraska has failed to meet its obligations to the State of Kansas under the Republican River Compact, and Kansas' water users have continued to suffer as a result. Although there are disagreements between Kansas and Nebraska on certain portions of the final accounting for 2005 and 2006, Nebraska is significantly out of compliance for this first period of Water-Short Year Administration regardless of which State's methodology is used. Further, although the accounting for 2007 is not yet available, it is clear that Nebraska will not be in compliance for the statewide five-year accounting period 2003 through 2007. The cumulative Nebraska overuse for 2003 through 2006 is 143,840 acre-feet. See Attachment 2 hereto. This is the amount that Nebraska needed to make up in 2007 in order to be in compliance for 2003-2007, an unlikely event. In addition, 2007 was also a Water-Short Year Administration year, and it is highly unlikely, as well, that Nebraska will meet the Water-Short Year Administration requirements for that year.

In light of the foregoing, Kansas proposes the remedy set out in Attachment 3 to this letter. The remedy includes: (1) entry of an order by the Supreme Court finding Nebraska in violation of the Court's Decree; (2) Kansas' damages for the years 2005-2006 or Nebraska's gains, whichever are greater, plus compounded interest and attorneys fees and costs, together with any additional relief that may be considered appropriate by the Court; and (3) (a) shutdown of wells and groundwater irrigation in Nebraska within 2 ½ miles of the Republican River and its tributaries, (b) shutdown of groundwater irrigation of acreage added after the year 2000 throughout the Republican River Basin in Nebraska and (c) such further reductions of net consumptive use in the Basin in Nebraska necessary to maintain yearly compliance, or the hydrologic equivalent of the foregoing. In addition, if Nebraska continues to be unable or unwilling to control its water users, further relief, including a Court-appointed River Master, may be necessary.

Supporting Materials

Although the most urgent need is to bring Nebraska into compliance, sanctions for the 2005-2006 violations are also appropriate. Kansas' preference is for repayment in water, but repayment in water by Nebraska appears to be impractical, given the overwhelming deficit that has been accumulated by Nebraska. Therefore, monetary payment is proposed, equal to the gains reaped by Nebraska as a direct result of violating the Court's decree, or Kansas' damages, whichever are greater. This should reduce Nebraska's incentive to violate the Court's Decree in the future.

During recent years, Nebraska's groundwater consumptive beneficial use has been approximately 200,000 acre-feet per year. Even with purchase of surface water and other actions by Nebraska, however, Nebraska has been significantly short of Compact compliance. Kansas' attached analysis demonstrates that Nebraska must reduce its annual groundwater consumptive use (depletions of the surface waters of the Republican River Basin in Nebraska) to 175,000 acre-feet per year, or otherwise achieve the hydrologic equivalent, to dependably meet its 5-year compliance test. See Attachment 4 hereto.

The stipulated RRCA Ground Water Model has been used to determine the extent to which ground water pumping must be curtailed in order to reduce and maintain river depletions caused by groundwater pumping in Nebraska down to 175,000 acre-feet per year. See Attachment 5 hereto. That analysis indicates that a reduction in groundwater irrigated acreage of approximately 515,000 acres is required of 1,201,000 irrigated acres assumed in the future case. As is demonstrated in Figure 4 of Attachment 5, failure to address groundwater depletions in a substantive way will result in continued loss of streamflow. Without this reduction in groundwater pumping, significantly less surface water will be available for existing irrigation projects and/or to assist in achieving Compact compliance. Immediate additional actions by Nebraska are also necessary to achieve near-term compliance. In the long term, further actions will likely be needed, especially in Water-Short Year Administration years.

Designated Schedule for Resolution

Kansas is proposing the foregoing remedies to address the past and continuing violations of the Supreme Court Decree in order that you may consider whether you can agree to these remedies. This situation comes as no surprise to you. Nebraska has been aware that its consumptive use has exceeded allocation every year since 2003. At the 2006 and 2007 Republican River Compact Administration meetings, for instance, Kansas pointed to the increasing likelihood that Nebraska would be out of compliance as soon as the data became available. In addition, by letter of January 24, 2007, Kansas specifically addressed the inadequacy of actions then being proposed in Nebraska as a means of bringing Nebraska into compliance.

Please review this proposal and respond to me within 45 days with regard to whether Nebraska is willing to agree to the proposed remedy. If we do not reach an agreement within that time period, Kansas will submit the dispute to the RRCA. If the dispute is not resolved by the RRCA, we will submit the dispute to the RRCA as a "fast track" issue and will proceed pursuant to the FSS Dispute Resolution procedure according to the schedule set out in Attachment 6 hereto, unless otherwise agreed.

Very truly yours,

David W. Barfield, P.E
Kansas Chief Engineer
Kansas RRCA Commissioner

cc: (w/encl.) (Via Email & U.S. Mail)
Kansas Attorney General Paul Morrison
Dick Wolfe, Colorado RRCA Commissioner
Aaron M. Thompson, U.S. Bureau of Reclamation
Col. Roger Wilson, Jr., U.S. Army Corps of Engineers
James J. DuBois, U.S. Department of Justice

Attachments:

Attachment 1 – Nebraska's Violations of the Final Settlement Stipulation: 2005-2006

Attachment 2 – Nebraska's Statewide Allocation and Computed Beneficial Consumptive Use: 2003-2006

Attachment 3 – Proposed Remedy for Violations of the Court's Decree

Attachment 4 – Engineering Report: Requirements for Nebraska's Compliance with the Republican

Attachment 5 – Report: RRCA Groundwater Model Analysis

Attachment 6 – Designated Schedule for Resolution

Attachment 1

Nebraska's Violation of Water-Short Year Administration Requirement 2005 and 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	249,689	11,965	(42,860)
2006	189,180	3,615	185,565	240,850	3,064	237,786	12,214	(40,010)
Average	194,320	4,100	190,210	247,300	3,560	243,740	12,090	(41,430)

*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 from an accounting consistent with 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.

The totals for 2005 and 2006 from table 5C are below:

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	388,630	8,200	380,430	494,590	7,120	487,470	24,180	(82,870)

Attachment 2

Nebraska's Five-Year Running Average Allocation and Computed Beneficial Consumptive Use for Determining Compact Compliance 2003 through 2006

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	Difference between Allocation and Computed Beneficial Consumptive Use minus Imported Water Supply
2003	227,580	262,780	9,782	(25,418)
2004	205,630	252,650	10,386	(36,640)
2005	199,450	253,740	11,965	(42,325)
2006	189,180	240,850	12,214	(39,456)
2007				
Average	205,460	252,510	11,090	(35,960)

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

The values for years 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 from an accounting consistent with 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.

The totals of table 3 C are below:

Year	Allocation	Computed Beneficial Consumptive Use	Credits from Imported Water Supply	Difference between Allocation and Computed Beneficial Consumptive Use minus Imported Water Supply
Totals for 2003 to 2006	821,840	1,010,020	44,350	(143,840)

Attachment 3

Proposed Remedy for Violation of the Court's Decree
in
Kansas v. Nebraska and Colorado,
No. 126, Orig., U.S. Supreme Court
Decree of May 29, 2003, 538 U.S. 720

1. Order of Supreme Court finding Nebraska in violation of the Court's Decree and imposing the following remedy.

2. For 2005-2006 violation of the Final Settlement Stipulation (FSS), Nebraska shall pay to Kansas the following:

   A. Kansas' damages or Nebraska's gains, whichever are greater;

   B. Prejudgment interest compounded from the date of Nebraska's overuse;

   C. Attorneys fees and costs; and

   D. Such further relief as may be considered appropriate by the Court to address fully the Decree violation by Nebraska.

3. To achieve compliance with the FSS in the future, Nebraska shall:

   A. Immediately (a) shut down wells and groundwater irrigation in Nebraska within 2 ½ miles of the Republican River and its tributaries, (b) shut down groundwater irrigation of acreage added after the year 2000 throughout the Republican River Basin in Nebraska and (c) such further reductions of net consumptive use in the Basin in Nebraska necessary to maintain yearly compliance. This will reduce groundwater consumptive use to approximately 175,000 acre-feet per year. Nebraska is invited to submit an alternative remedy that is the hydrologic equivalent in quantity and timing;

   B. Further reduce Nebraska's Computed Beneficial Consumptive Use to the extent necessary to keep Nebraska (1) within its Compact allocation until the effects of the reduction of groundwater pumping brings Nebraska into compliance with the Compact and the FSS, and (2) in compliance when the actions listed above in are insufficient, especially in Water-Short Year Administration years;

   C. Be subject to preset damages, costs, attorneys' fees, and additional sanctions for any failure to comply with the Court's order in the future.

Attachment 4

Requirements for Nebraska's Compliance with the Republican River Compact

Report to

David Barfield

Kansas Department of Agriculture, Division of Water Resources

from

Spronk Water Engineers, Inc.

Dale E. Book, P.E.

December 18, 2007

Introduction

This report describes the analysis made to determine the reductions in Groundwater Computed Beneficial Consumptive Use (CBCU) necessary in Nebraska to achieve compliance with the Republican River Compact as implemented by the Final Settlement Stipulation (FSS). Nebraska's CBCU exceeded the allocation above Guide Rock for the two-year water short year test applied to 2005 and 2006. The expected result for the five-year period of 2003 through 2007 is that Nebraska's statewide CBCU will exceed its corresponding allocation. For the four years of 2003 through 2006, Nebraska's statewide CBCU has exceeded allocations by a total of 143,840 acre-feet using the Kansas methodology.

The analysis described in this report is intended to estimate the level of Groundwater CBCU that could occur within Nebraska's allocation to achieve compliance with the five-year test. Compliance with the Water Short year standard would require that additional reduction of surface water CBCU or equivalent offset be supplied. This analysis was intended to quantify the level of groundwater CBCU that could occur within Nebraska's allocation. The RRCA Groundwater model was used to determine reductions in pumping that would be necessary to achieve this level of CBCU (see Attachment 5).

This analysis relies on the data for the period of 2002 - 2006 to compare CBCU with the allocation under the Republican River Compact. This comparison provides the amount of groundwater CBCU that can occur, in combination with the limited surface water CBCU of this period, to achieve compliance with the FSS for this period. The amount of groundwater CBCU that can occur is a reduction from recent levels of groundwater CBCU of approximately 200,000 acre-feet/year. The RRCA groundwater model was used to quantify the projected groundwater depletions in Nebraska resulting from reductions in pumping as well as changes to Imported Water Supply Credits that would occur with the reduced groundwater pumping. The projected effects of these reductions on surface water CBCU and compliance with the FSS over this period were estimated.

Criteria and Assumptions

The level of groundwater CBCU that would allow the total CBCU to be within the allocation over the five-year period of 2002 through 2006 was determined as follows. The increased streamflow caused by a proposed level of pumping reduction would increase the supply available for surface water use in Nebraska and increase supply available to Kansas. The net change of Nebraska use was estimated assuming that additional water would be consumed by the surface water users as a result of the increased supply.

The level of groundwater depletion that would provide compliance with the five-year statewide standard in Nebraska was determined by estimating the change in groundwater CBCU, surface water CBCU, and Imported Water Supply Credits and then comparing the resulting net total CBCU to the allocation for the five-year period. The analysis is based on the following criteria and assumptions:

- CBCU should not exceed the statewide allocation, over a five-year period.
- The Imported Water Supply Credit was estimated from analysis with the RRCA Groundwater Model
- Reductions in CBCU necessary to achieve compliance are assumed to be accomplished from reductions in groundwater irrigation pumping, as represented in the groundwater model simulation.
- Surface water CBCU in Nebraska would be increased due to increased streamflow.
- Compliance with the two-year standard for water short conditions may require reduction in surface water use, in addition to the pumping reductions.
- The time required for groundwater CBCU, as predicted with the RRCA Groundwater model, to decline to the necessary level will be several years. Until CBCU is reduced to that level, other reductions will be needed to achieve compliance.

Description of Analysis

The analysis computes the change in statewide CBCU corresponding to a reduced level of groundwater depletions. It is necessary to reduce the groundwater depletions by more than the actual deficit, since additional surface water consumptive use would be expected to occur, as a result of the increased streamflow resulting from less depletion to streamflow from groundwater pumping.

Using available compact data, the five-year average statewide allocation over the period of 2002 - 2006 was 212,000 acre-feet/year. Table 1 shows the actual FSS accounting for this period. The overuse averaged 32,000 acre-feet/year for this period.

The amount of increased surface water consumptive use in Nebraska was estimated, based on the location of the changes in groundwater depletions. For the storage conditions in effect during these years, it was assumed that the increased flows would be largely diverted for irrigation, with some additional reservoir evaporation. The amount of additional streamflow that would be consumed by surface water uses in Nebraska was estimated to be 45%. Table 1 shows the adjusted CBCU and the comparison with the allocation.

The Imported Water Supply Credit was estimated using the RRCA Groundwater Model, with the projected future level of pumping determined from this analysis. The credit was estimated to be approximately 30,000 acre-feet/year. Actual credit would of course depend on the amounts of continued importation of Platte River water into the basin.

Results of Analysis

1. The average annual allocation for Nebraska for 2002 - 2006 was 212,000 acre-feet/year. The actual use, including both surface and groundwater, averaged 254,000 acre-feet/year. After adjusting for the Imported Water Supply Credit, the Computed Beneficial Consumptive Use exceeded the allocation by 32,000 acre-feet/year.

2. When the groundwater CBCU is reduced to 175,000 acre-feet/yr, average surface water CBCU is estimated to increase from 55,000 to 67,000 acre-feet/year. Imported Water Supply Credits increase to approximately 30,000 acre-feet/year.

3. The total CBCU that could occur within the Nebraska's allocation is 242,000 acre-feet/yr, after applying the estimated Imported Water Supply Credit.

4. The Groundwater CBCU must be reduced to 175,000 acre-feet/yr to achieve a balance with the statewide allocation over the five year period.

Conclusions

The Nebraska beneficial consumptive use has exceeded the statewide allocation for each of the years 2002 - 2006. The five-year total for the period of 2003 - 2007 is expected to exceed the allocation over that period, given the status of the accounting through 2006. Based on the five-year allocation through 2006, it would be necessary to reduce the total CBCU to approximately 242,000 acre-feet/year for Nebraska to be in compliance with the FSS.

A reduction of stream depletions due to groundwater pumping in Nebraska from 200,000 to 175,000 acre-feet was estimated to be necessary to provide compliance with the five-year test of the FSS over a period of similar water supply conditions. This would result in a balance between CBCU and allocation. This level of groundwater depletions corresponds to the pumping reductions described in Attachment 5.

To achieve compliance with the Water-short year periods, additional reductions to CBCU beyond those described above will be necessary. It would be necessary to limit surface water consumptive use or provide equivalent offsets from alternate sources.

Table 1

Estimated Effect on Compliance from a Reduction in Nebraska's Pumping: 2002 - 2006

(1000 acre-ft)

Table 3C: Nebraska's Five-Year Average Allocation and CBCU					
Year	Actual				
	Statewide Allocation	Ground Water CBCU	Surface Water CBCU	Imported Water Supply Credit	Allocation - (CBCU - IWS Credit)
2002	237	180	85	14	-15
2003	228	204	59	10	-25
2004	206	213	40	10	-37
2005	199	203	51	12	-42
2006	189	198	42	12	-39
Average	212	200	55	12	-32

Year	Adjusted				
	Ground Water [1] CBCU	Effect on [2] Nebraska's Surface Water CBCU	Surface Water [3] CBCU	Imported Water [4] Supply Credit	Allocation - [5] (Adjusted CBCU - IWS Credit)
2002	175	2	88	30	4
2003	175	13	72	30	11
2004	175	17	57	30	4
2005	175	13	63	30	-9
2006	175	11	53	30	-9
Average	175	11	67	30	0

[1] Nebraska's projected amount of Ground Water CBCU

[2] 45% of the difference between the actual Ground Water CBCU and adjusted Ground Water CBCU

[3] Adjusted Surface Water CBCU = the actual surface water CBCU plus the Effect on Nebraska's Surface Water CBCU

[4] Nebraska's projected Imported Water Supply Credit

[5] Adjusted compliance = Nebraska's allocation - (the adjusted Ground Water CBCU + the adjusted Surface Water CBCU - the adjusted imported water supply credit)

Attachment 5: RRCA groundwater model analysis (revised)
Impact of Nebraska pumping and proposed remedy

Samuel P. Perkins[1] and Steven P. Larson[2]
January 4, 2008
(see Appendix A for an explanation of revisions)

[1]Civil Engineer, Interstate Water Issues, Kansas Dept. Of Agriculture, Div. of Water Resources;
[2]S. S. Papadopulos & Associates, Inc., Bethesda, MD.

Introduction

The analysis described in Attachment 4 has shown that annual groundwater consumptive use in Nebraska must be reduced to 175,000 acre-feet in order to achieve sustained compliance with the compact. The approved RRCA groundwater model was used to determine the reduction in pumping necessary for Nebraska to meet this requirement and thereby achieve sustained compliance with the Republican River Compact. This memo describes the basis for the projected depletions computed by the groundwater model under both status quo and reduced pumping scenarios.

In order to reach and then sustain a groundwater consumptive use of 175,000 acre-feet (AF) needed to comply with the Compact over the next 50 years, the proposed remedy case imposes the following conditions on future groundwater pumping for irrigation within the Republican River basin in Nebraska: first, a no-pumping zone for irrigation is imposed within 2.5 miles of RRCA groundwater model stream cells; second, groundwater irrigation area is held at 2000 levels at distances greater than 2.5 miles from stream cells; third, commingled irrigation area is held at 2006 levels at all distances from stream cells within the Republican River basin in Nebraska. Under this scenario, future groundwater irrigation area in Nebraska is reduced by 514,610 acres, including 350,970 acres within the no-pumping zone and 163,640 acres outside the no-pumping zone. For comparison, Nebraska's reported groundwater irrigated acreage within the Republican River basin has increased by 211,000 acres since 2000 and by 309,900 acres since 1990.

The proposed remedy is intended to allow recovery of streamflow as quickly as groundwater response will allow by focusing on groundwater pumping near the Republican River and its tributaries. The groundwater model was used to represent impacts of Nebraska groundwater pumping on Republican river streamflow and of imported water supply from the Platte River. Model scenarios were run to represent both status quo conditions and the proposed remedy. Projected Nebraska impacts for a 51-year future time period, as well as computed Republican River streamflow, are presented here under both scenarios.

Projected average annual impacts over 51 years (2007-2057) on Republican River streamflow under status quo conditions are 268,000 acre-feet per year (afy) for Nebraska groundwater pumping, reduced by 11,700 afy for imported water supply credit from Platte River imports, for a net impact of 256,300 afy. The corresponding impacts under the reduced pumping scenario are 164,700 afy for Nebraska pumping, reduced by 27,600 afy for imported water supply credits, for a net impact of 137,100 afy. Compared with the base case scenario, the proposed remedy scenario shows an average decrease in pumping impact of 103,300 afy and increase in imported water supply credit of 16,000 afy, for a reduction in Nebraska's net impact of 119,300 afy. However, the net impact under the proposed remedy shows an initial decline followed by an upward trend for years 2015-2057, indicating a possibly larger net impact beyond the simulated time period.

Using a sequence of historical years to represent futures

Model datasets for historical years 1990-2006 were used to construct future scenarios. These years were chosen initially because of the higher quality of Kansas water use reporting data beginning in 1990. The sequence of historical years 1990-2006, beginning with year 1990, was repeated three times to represent future scenarios for years 2007-2057. Median annual precipitation for years 1990-

2006, spatially averaged over the groundwater model domain, is 19.58 inches/year. Compared against the model's years of record 1918-2006, this corresponds to a probability of 54.5 percentile, which is slightly above median rainfall of 19.28 in/yr for years 1918-2006. This indicates that the sequence is a reasonable projection, at least with respect to the historical record. Additionally, the sequence consists of a relatively wet period (1990-1999) followed by a relatively dry period (2000-2006).

Hydrologic conditions for future years were represented by the conditions of the historical sequence of years. These conditions include mean monthly streamflow and reservoir elevations at the end of each month, both of which are specified for the stream (STR) package, and evapotranspiration (for the EVT package) as input to Modflow (mf2k). Groundwater recharge, pumping and irrigated area are also based on conditions of the historical sequence of years, but with adjustments to specify conditions for the specific cases as input files to the pumping (WEL) and recharge (RCH) packages. Irrigated area is a consideration due to the dependence of precipitation recharge on whether or not the land is irrigated. Input files to Modflow were assembled by the preprocessor programs mketff (EVT package), mkstrff (STR package) and rrppf (RCH and WEL packages) [version: rrppf_v519].

Status quo scenario

Recharge and pumping for the status quo scenario were represented by historical conditions with adjustments as follows.

Kansas data for irrigated area, groundwater pumping and return flow in future years were based on corresponding historical years' data, but with adjustments to reflect 2006 conditions with respect to return flow (based on improvements in irrigation systems), metering and development.

Data for irrigated area served by groundwater and commingled pumping as reported in 2006 by Colorado and Nebraska were used to represent all future years under base case conditions. Irrigated area served by surface water in future years was represented by data for the corresponding historical years. For Colorado, 2006 groundwater irrigated area was substituted for the corresponding historical years' area as a correction to the Colorado dataset from authorized area, as specified in years 1990-2000, to reported area used for irrigation, as specified in years 2001-2006. No corresponding adjustment was made to groundwater pumping for Colorado.

In the case of Nebraska, 2006 groundwater and commingled irrigated area were substituted for corresponding historical years' data in order to represent continued development through 2006. Groundwater pumping by Nebraska in future years was represented by reported pumping in the corresponding historical years to reflect hydrological conditions. To reflect the change in development associated with irrigation from a given historical year to the year 2006, historical pumping corresponding to each grid cell was multiplied by the ratio of total groundwater and commingled irrigated area in 2006 to the total area for the corresponding historical year. In order to reflect differences in development across Natural Resource Districts in Nebraska, this ratio was calculated for each NRD within the groundwater model domain, and applied to total reported pumping and groundwater return flow for each model grid cell within the corresponding District. NRD boundaries are shown in Figure 1.

The assumptions of historical conditions for the Nebraska dataset that are projected into the future include return flow from groundwater pumping for irrigation, which is assumed to be 20 percent. This is considered to be a generous assumption, even for recent historical years, and may warrant revision for scenario refinements, especially if allocations imposed by Natural Resource Districts are to be incorporated.

Proposed remedy case: reduced Nebraska pumping scenario

Conditions for the reduced Nebraska pumping scenario are summarized above in the Introduction. The conditions are explained in greater detail as follows.

No-pumping zone

The no-pumping zone was specified in terms of model grid cells as an approximation of an actual zone, which would likely be independent of the model grid; for example, it might reference a boundary based on the Public Land Survey System. The grid-based approximation has the advantage of allowing the affected pumping in Nebraska to be selected from datasets previously prepared by Nebraska for the model, including groundwater pumping, recharge and irrigated area. Additionally, defining the no-pumping zone with reference to model stream cell centers is intended to be consistent with prior decisions made during model development to represent the stream network.

Figure 1 shows the extent of the proposed no-pumping zone on Nebraska groundwater pumping for irrigation within the Republican River basin as gray-shaded grid cells. Model cells representing streams and federal reservoirs (turquoise) are included in the no-pumping zone. By selecting model grid cells whose centers lie within two miles of stream cell centers, the resulting no-pumping zone applies to groundwater diversions within 2.5 miles of the stream. The model grid cells corresponding to the no-pumping zone were selected in GIS and converted into a "mask", i.e., an array of 1's and 0's that was written to a text file for input to a preprocessor to identify grid cells for which pumping is to be excluded.

2000 irrigated area

Outside the no-pumping zone, groundwater irrigation area for the year 2000 was substituted for corresponding historical years' data to hold development at 2000 levels. Groundwater pumping by Nebraska in future years was represented by reported pumping in the corresponding historical years to reflect hydrological conditions, multiplied by a factor to reflect the change in irrigated area, given by the ratio of groundwater irrigated area in 2000 to groundwater irrigated area in the corresponding historical year. Ratios were calculated for each Natural Resource District (NRD) and applied to corresponding pumping within the NRD.

An implicit assumption of the above conditions for the proposed remedy scenario is that pumping within the no-pumping zone cannot be transferred outside the zone.

The combined effects of imposing the no-pumping zone and fixing irrigated area at 2000 elsewhere in the Republican River basin are to reduce groundwater irrigated area within the Republican River basin by 514,600 acres, or 43 percent, from 1,200,600 acres under the status quo scenario to 686,000 acres under the proposed remedy.

Commingled irrigated area

In applying the proposed remedy, the condition to hold groundwater irrigation area to 2000 levels is not applied to commingled irrigation area, which is instead held at 2006 levels for all of Nebraska within the RRCA groundwater model domain. Within the no-pumping zone, commingled irrigation area is retained, under the assumption that commingled area could be irrigated if surface water is available. Total 2006 commingled irrigated area in Nebraska was 119,000 acres. Within the no-pump zone, 2006 commingled irrigation area was 11,040 acres; Within the Republican River basin and outside the no-pump zone, 2006 commingled area was 2,230 acres.

Evaluation of impacts of Nebraska pumping under status quo and reduced pumping conditions

In order to compute Nebraska impacts of both groundwater pumping and imported water supply, three additional cases were run for comparison against the status quo and reduced pumping cases, above. Conditions for the third case specify no groundwater pumping in Nebraska for the entire simulation

period, beginning in 1918, but are otherwise the same as conditions for the base case. Similarly, conditions for the fourth case specify no imported water supply from the Platte River in Nebraska for the entire simulation period, beginning in 1918, but are otherwise the same as conditions for the base case. The fifth case is identical to the reduced pumping cases (above), except for the assumption that future imported water supplies from the Platte River are excluded.

Based on these five future scenario runs, impacts of Nebraska pumping and imported water supply were evaluated with respect to both baseline and reduced pumping conditions. First, the impact of Nebraska pumping under status quo conditions was evaluated as the difference given by computed Republican River flows for the "no Nebraska pumping" case minus corresponding flows for the status quo case. Second, the impact of Nebraska pumping under the proposed remedy is evaluated as the difference given by computed Republican River flows for the "no Nebraska pumping" case minus corresponding flows for the proposed remedy case. Similarly, imported water supply credits were evaluated twice: first, with respect to status quo conditions, and then with respect to reduced pumping conditions under the proposed remedy case.

Results: impacts of Nebraska pumping and imported water supply from Platte River

The reduction in groundwater irrigated area of 514,600 acres within the Republican River basin under the proposed remedy results in a groundwater pumping reduction of 619,900 acre-feet/year. Impacts of this reduction on streamflow are presented here.

Table 1 lists computed annual impacts of Nebraska pumping on Republican River streamflow and of imported water supply under both the status quo and reduced pumping scenarios for years 2007-2057, and averages over the same period. The rightmost column of Table 1 lists the reduction of impacts achieved under the reduced pumping scenario.

Table 1 shows that projected average annual impacts over 51 years (2007-2057) on Republican River streamflow under baseline, conditions are 268,000 acre-feet/per year (afy) for Nebraska groundwater pumping, reduced by 11,700 afy for imports from the Platte River, for a net impact of 256,300 afy. The corresponding impacts under the reduced pumping scenario are 164,700 afy for Nebraska pumping, reduced by 27,600 afy for imported water supply for a net average impact of 137,100 afy. Compared with the base case scenario, the proposed remedy scenario shows an average decreased pumping impact of 103,300 afy, and an increase in imported water supply credit of 16,000 afy, for an average net Nebraska impact reduction of 119,300 afy. However, the net impact under the proposed remedy shows an initial decline followed by an upward trend for years 2015-2057 that indicates a possibly larger net impact beyond the modeled time period.

Nebraska impacts on Republican River streamflow are shown graphically in Figures 2 and 3. Figure 2 shows the separate impacts of Nebraska pumping and imported water supply credit under both scenarios. Figure 3 shows the net sum of pumping impact and imported water supply credit for each scenario.

Figure 2 shows historical impacts of Nebraska pumping on Republican River streamflow and imported water supply credit according to the RRCA groundwater model for years 1960-2006. The historical impact of Nebraska pumping reached peak levels of 212,900 acre-feet/year in 2001 and 213,100 acre-feet/year in 2004, and was 198,400 acre-feet/year in 2006. Figure 2 also shows projected impacts of Nebraska pumping on Republican River streamflow and imported water supply credit under both the status quo scenario and the reduced pumping scenarios for years 2007-2057.

The impact of Nebraska pumping on Republican River streamflow in future years under the status quo scenario shows greater variability than under the reduced pumping scenario because of the greater magnitudes of the pumping under the status quo scenario. Projected pumping impacts under both scenarios appear to have upward trends, although impacts under status quo conditions show a

decreasing rate of change. Imported water supply credits under the proposed remedy are greater and show less variability than do those under status quo conditions.

Table 1. Projected impacts of Nebraska pumping and Platte River imports under both status quo conditions and the proposed remedy (acre-feet/year)

year	Status quo conditions			Proposed remedy			Impact reduction
	pumping	imports	Net impact	pumping	imports	Net impact	
2007	206,685	15,945	190,740	189,290	17,476	171,814	18,926
2008	228,723	10,519	218,204	185,972	18,160	167,812	50,392
2009	232,212	10,058	222,154	184,619	24,438	160,181	61,973
2010	268,248	28,216	240,032	188,316	28,869	159,447	80,585
2011	234,826	18,396	216,430	167,740	23,517	144,223	72,207
2012	257,288	16,004	241,284	169,116	25,785	143,331	97,953
2013	279,390	19,589	259,801	170,714	27,116	143,598	116,203
2014	253,960	20,178	233,782	161,514	25,630	135,884	97,898
2015	239,184	13,010	226,174	153,278	24,317	128,961	97,213
2016	259,639	12,697	246,942	162,518	27,757	134,761	112,181
2017	235,315	12,933	222,382	149,632	23,936	125,696	96,686
2018	249,836	11,921	237,915	151,570	26,762	124,808	113,107
2019	220,215	8,478	211,737	137,938	20,590	117,348	94,389
2020	239,380	9,005	230,375	151,122	25,655	125,467	104,908
2021	249,061	9,087	239,974	155,209	27,349	127,860	112,114
2022	248,073	9,400	238,673	152,490	25,855	126,635	112,038
2023	232,745	9,054	223,691	148,589	26,396	122,193	101,498
2024	241,650	9,967	231,683	150,586	25,203	125,383	106,300
2025	260,704	8,756	251,948	158,291	26,119	132,172	119,776
2026	261,893	9,493	252,400	159,352	27,569	131,783	120,617
2027	310,470	20,000	290,470	168,124	29,958	138,166	152,304
2028	266,199	17,524	248,675	157,838	27,737	130,101	118,574
2029	288,790	11,750	277,040	161,625	29,072	132,553	144,487
2030	315,741	13,507	302,234	167,204	30,214	136,990	165,244
2031	281,880	17,106	264,774	161,227	29,113	132,114	132,660
2032	268,225	9,908	258,317	155,858	27,867	127,991	130,326
2033	287,840	10,699	277,141	165,875	30,366	135,509	141,632
2034	260,095	9,511	250,584	155,124	27,216	127,908	122,676
2035	275,704	9,444	266,260	157,893	29,493	128,400	137,860
2036	240,324	7,342	232,982	146,034	23,234	122,800	110,182
2037	253,962	8,401	245,561	159,222	28,213	131,009	114,552
2038	268,318	8,603	259,715	163,913	29,615	134,298	125,417
2039	272,377	9,011	263,366	161,569	28,314	133,255	130,111
2040	254,226	8,699	245,527	158,492	28,645	129,847	115,680
2041	262,968	8,440	254,528	160,150	27,552	132,598	121,930
2042	281,574	8,280	273,294	169,229	28,218	141,011	132,283
2043	282,715	9,153	273,562	170,738	29,665	141,073	132,489
2044	340,444	14,502	325,942	180,788	32,343	148,445	177,497
2045	285,259	15,373	269,886	168,711	29,938	138,773	131,113
2046	310,820	9,985	300,835	173,741	31,303	142,438	158,397
2047	339,785	11,229	328,556	180,301	32,442	147,859	180,697
2048	302,494	15,013	287,481	174,016	31,491	142,525	144,956
2049	286,563	8,973	277,590	167,400	29,872	137,528	140,062
2050	305,555	10,562	294,993	179,129	32,415	146,714	148,279
2051	278,614	8,926	269,688	167,245	29,129	138,116	131,572
2052	293,521	9,281	284,240	170,714	31,589	139,125	145,115
2053	250,743	6,952	243,791	156,746	24,702	132,044	111,747
2054	265,943	8,337	257,606	171,879	29,872	142,007	115,599
2055	280,141	8,709	271,432	176,507	31,446	145,061	126,371

2056	287,984	8,969	279,015	174,543	30,068	144,475	134,540
2057	270,883	8,707	262,176	169,789	30,174	139,615	122,561
2007-2057	268,023	11,678	256,345	164,696	27,643	137,053	119,292

Figure 2 shows that the impact of Nebraska pumping under the proposed remedy is projected to fall below 175,000 acre-feet/year for the first time in 2011, or in the fifth year of the future scenario, and then occasionally exceeds 175,000 acre-feet/year beginning in 2044. Based on linear trends for years 2011-2057, the impact of Nebraska pumping increases by 394 acre-feet/year under the proposed remedy, and by 1,055 afy under status quo conditions.

Figure 3 shows that the net impact of Nebraska pumping and imported water supply under the proposed remedy is projected to fall below 150,000 acre-feet/year for the first time in 2011, and then stay below 150,000 acre-feet/year for the remaining years of the simulation. Based on linear trends for years 2011-2057, the net impact of Nebraska pumping and imported water supply increases by 261 acre-feet/year under the proposed remedy, and by 1,179 afy under status quo conditions.

Figure 4 shows computed Republican River flows contributed by groundwater for the historical period 1960-2006 and for the two scenarios 2007-2057. Under status quo conditions, computed annual flows for years 1960-2057 diminish at an average rate of 2.5 percent per year, based on an exponential trend for years 2011-2057, as shown in Figure 4. Under the proposed remedy scenario, computed flows after 2006 show relatively rapid recovery during the first few years, followed by an average rate of decline of 0.23 percent per year, based on an exponential trend for years 2011-2057.

Future hydrologic conditions

It is important to keep in mind that the projections, particularly on an annual basis or in the short term, are dependent on the hydrological conditions of the assumed sequence of years. Because of this, the time required to reduce the impact of Nebraska pumping to less than 175,000 acre-feet/year, and the net impact of Nebraska pumping and imported water supply to less than 150,000 acre-feet/year, will be influenced by future and unknown hydrological conditions.

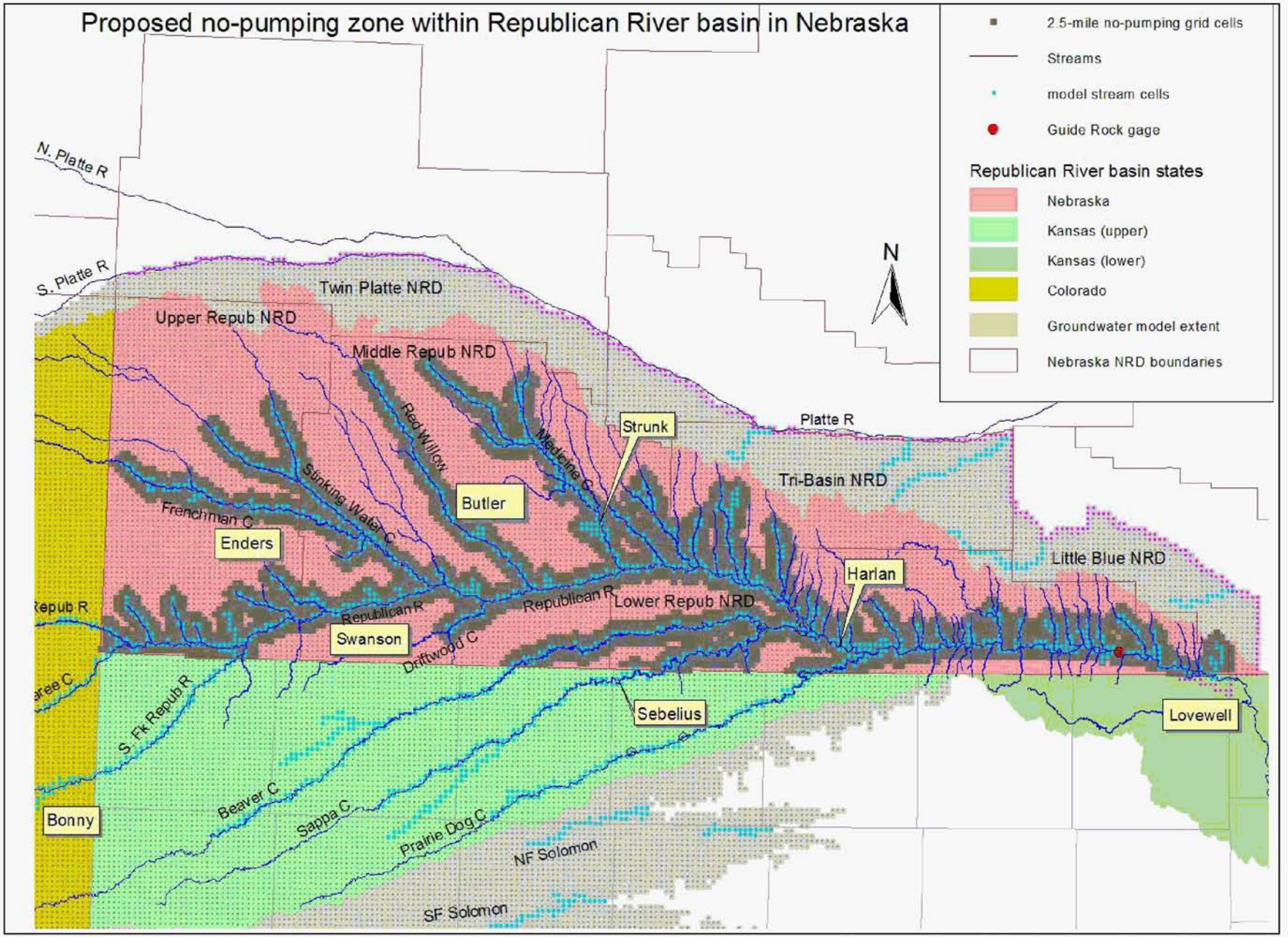

Fig. 1. Map showing part of RRCA groundwater model grid domain. Proposed no-pumping zone lies within the Republican River basin in Nebraska. Grid cells shaded dark gray are those whose centers lie within two miles of centers of stream cells (turquoise).

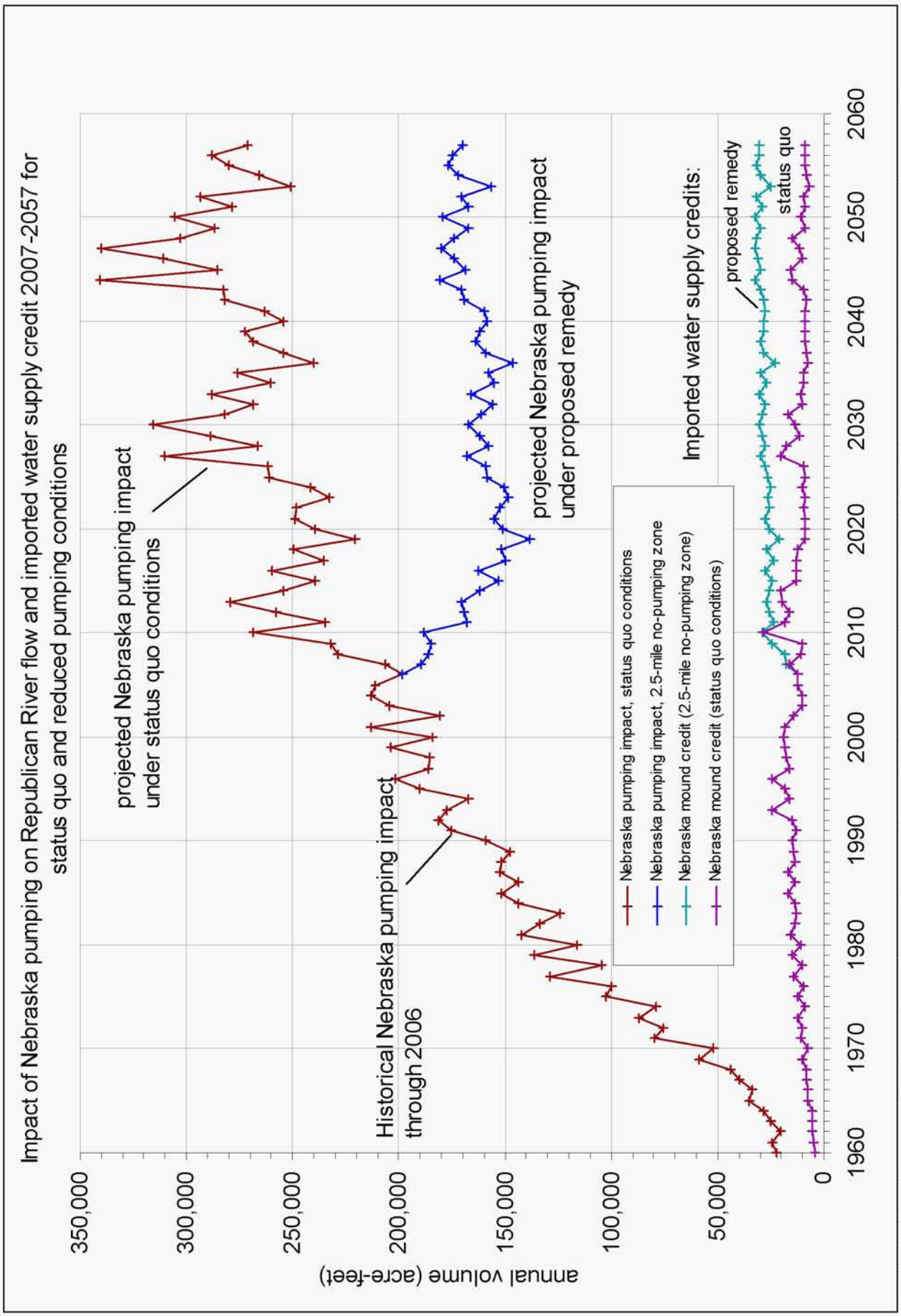

Fig. 2. Nebraska pumping impact on streamflow and imported water supply credit for both status quo and proposed remedy scenarios.

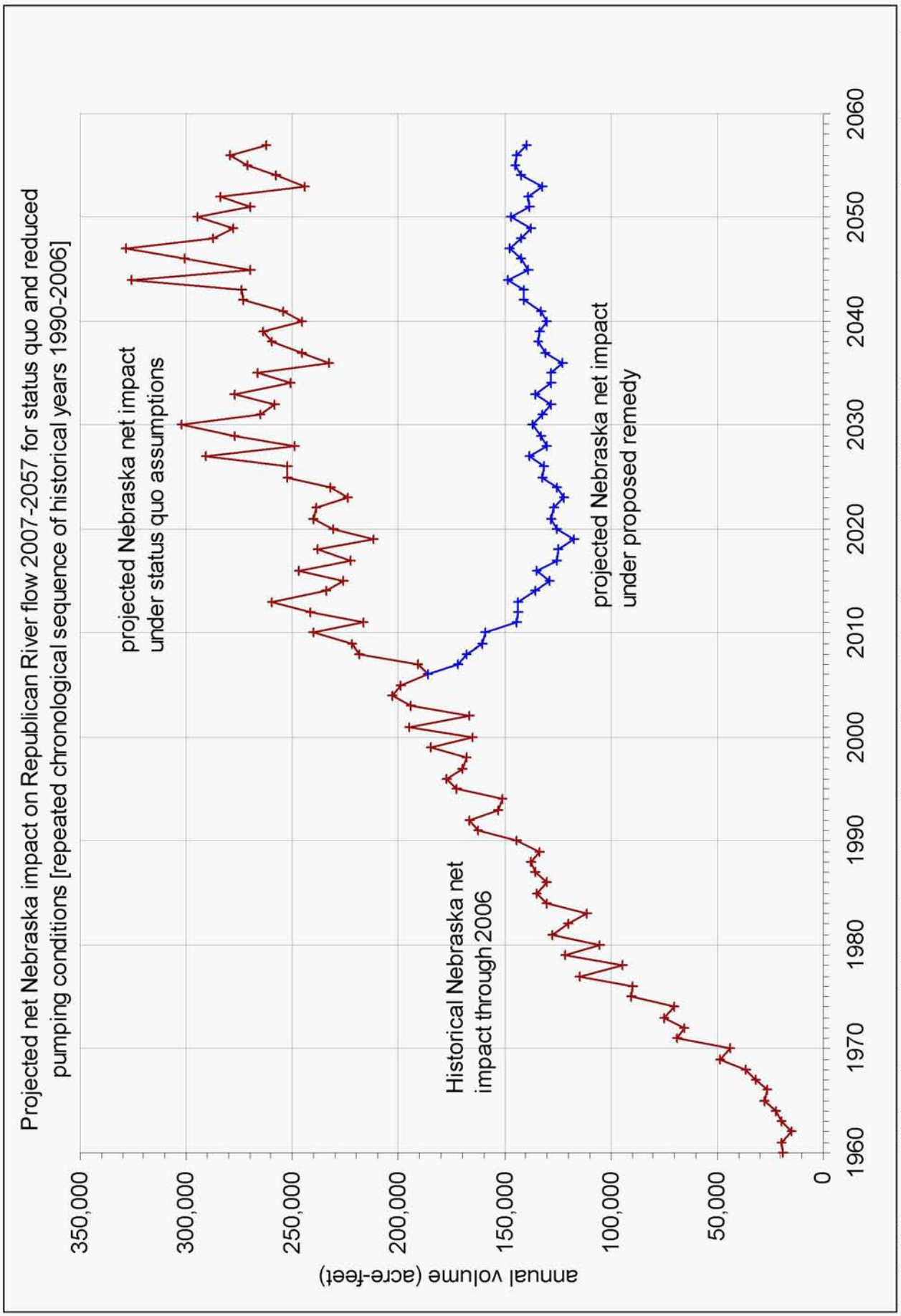

Fig. 3. Net sum of Nebraska pumping impact on streamflow and imported water supply credit for status quo and proposed remedy scenarios.

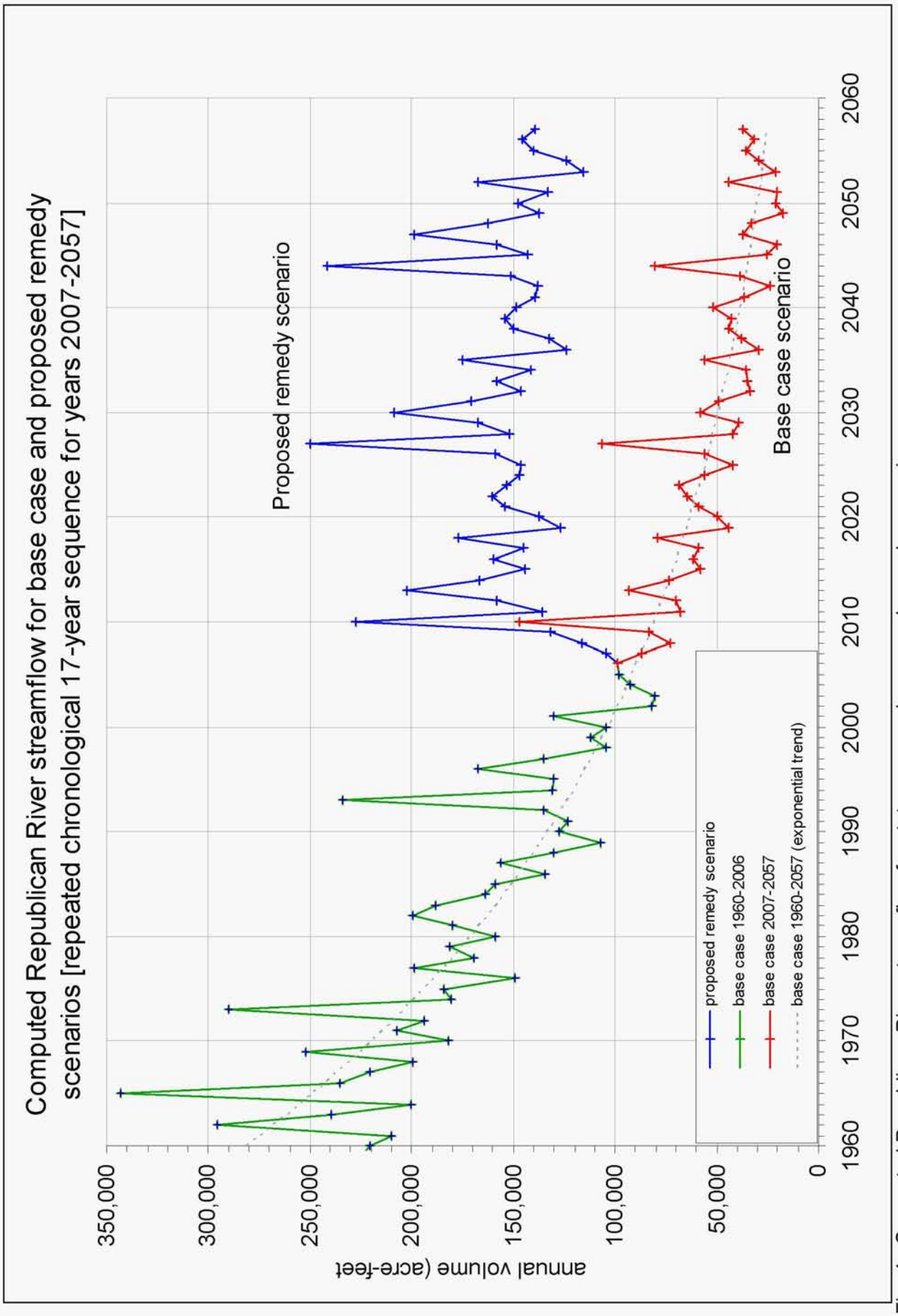

Fig. 4. Computed Republican River streamflow for status quo and proposed remedy scenarios.

Attachment 6

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

Designated Schedule for Resolution

December 19, 2007	Kansas provides proposed remedy to Nebraska with copies to Colorado and United States.
February 4, 2008	If agreement is not reached, Kansas submits dispute to the Republican River Compact Administration (RRCA) as a "fast-track" issue.
March 5, 2008	By this date, the RRCA meets to resolve the dispute.
March 20, 2008	If the RRCA fails to resolve the dispute, Kansas invokes nonbinding arbitration.
April 3, 2008	Kansas or Nebraska may amend the scope of the dispute to address additional issues.
April 17, 2008	Kansas and Nebraska submit names of proposed arbitrators and qualifications to each other.
April 28, 2008	Kansas and Nebraska representatives meet in person or by telephone to confer and agree on arbitrators; if agreement cannot be reached, the selection is submitted to CDR Associates of Boulder, Colo.
May 1, 2008	Arbitrators engaged.
May 12, 2008	Initial meeting/scheduling conference of Kansas and Nebraska before the arbitrators.
November 12, 2008	Deadline to complete arbitration and render decision.
December 12, 2008	Kansas and Nebraska give written notice whether they will accept the arbitrators' decision.
Thereafter	If the dispute is not resolved, Kansas makes the appropriate filings in the U.S. Supreme Court.