Non-binding Arbitrations Before
Jeffrey C. Fereday, Arbitrator

Initiated Pursuant to Final Settlement Stipulation
Kansas v. Nebraska & Colorado
No. 126, Orig., U.S. Supreme Court
Decree of May 29, 2003, 538 U.S. 720

Nebraska's N-CORPE Augmentation Plan
(Arbitration Initiated July 10, 2013)

PRE-FILED TESTIMONY OF KANSAS EXPERT DALE E. BOOK, P.E.

February 24, 2014

Q: What is your current professional position?

A: I am currently employed as a Principal Engineer with the consulting firm of Spronk Water Engineers, Inc., located in Denver, Colorado. I am president of the firm. The firm provides consulting services in the areas of water resources, water rights engineering and water supply planning. I have been with the firm since its inception in 1984. Ex. WSY/RC K4 is my curriculum vitae.

Q: Please describe your education and professional experience as it relates to the matters in this hearing.

A: I have a bachelor's and master's degree in civil engineering, with a specialty in water resources. My master's degree was obtained in 1980. I have been a consulting engineer specializing in water resources and water rights for more than 30 years.

Q: Would you summarize your experience as a water resources engineer?

A: My experience has been related to water supply development within the prior appropriation system, primarily in the western United States. Areas of specialization include quantification of water supply, water use demands, irrigation engineering, including crop demand, irrigation systems evaluation and management. Our clients include municipalities, irrigation districts, state agencies and private water users. Our work includes collection and processing hydrologic data and river basin modeling. An important element of this work is to assess impacts of water use on streamflow and available water supply.

Q: Would you generally describe water rights engineering?

A: Water rights engineering involves determination of available water supply distributed pursuant to water rights and requires knowledge and analysis of

hydrology, water demands, water use structures and consumption of water. Analyses typically involve determination of yields over a range of water supply. An important aspect is to assess impacts of changes of water rights on the stream system and other water users. Water rights engineering requires an understanding of administration of water under the prior appropriation system. The administration of interstate compacts is a specialized area of water rights, involving allocation of water supplies over ranges of conditions and water use accounting.

Q: Would you summarize your technical background as it relates to this matter?

A: My technical experience is specialized in issues related to water resources engineering, including water supply, river basin analysis, stream-aquifer interaction, reservoir operations, hydrology and irrigation. I am experienced in the development and use of river basin and groundwater models. I also have experience with irrigation management and crop consumptive use, which is the primary form of water use in the Republican River Basin.

Q: In which states have you worked in on such matters?

A: I have worked in other river basins in Colorado, Kansas, New Mexico, Montana, Wyoming, Idaho, and Oregon.

Q: Have you testified previously as an expert?

A: Yes, I have. I have testified in various district water courts in the State of Colorado as an expert witness in water resources and water rights engineering. My experience has been related to water rights applications and changes and

plans for augmentation. I have also testified before the U.S. Supreme Court in the cases of *Kansas v. Colorado*, No. 105, Original and Kansas v. Nebraska & Colorado, No. 126, Original. I have also testified in the Supreme Court case of Montana v. Wyoming, No. 137 Original, in October of 2013.

Q: In what areas have you been accepted as an expert in those proceedings?

A: I have testified as an expert in the areas of water resources engineering, water rights, hydrology, river basin hydrologic modeling, and irrigation engineering.

Q: Would you please describe your experience working on matters in the Republican River Basin?

A: Since 1994, I have assisted the State of Kansas as a consultant on matters related to the Republican River Compact. I have conducted various investigations related to compact compliance issues as they evolved over the years, since 1994. I participated in the proceedings and settlement negotiations in *Kansas v. Nebraska & Colorado* which resulted in the Final Settlement Stipulation ("FSS"). I was a member of the technical committee that developed the RRCA Groundwater Model (Model) used for annual compact accounting. I participated in the negotiations that developed the FSS and the RRCA Accounting Procedures contained in Appendix C of the FSS. Since the entry of the Court's Decree approving the FSS I have continued to assist the State of Kansas in evaluations of compliance with the FSS as it related to the uses both in Nebraska and Colorado. I have provided expert witness testimony in Kansas v. Nebraska & Colorado, No. 126 Original, which went to trial before the Special

Master for the Supreme Court in 2012. I also provided expert witness testimony in the two previous arbitration cases conducted pursuant to the FSS.

Q: Are you familiar with stream augmentation plans through your work?

A: Yes, the development and implementation of stream augmentation as a management tool for water rights administration is common in the State of Colorado as a means to facilitate new development of water supply in basins that are normally fully appropriated. Such use is generally facilitated by changes of existing water rights or importation of water from outside of the basin. Augmentation plans provide replacement supplies to the stream to facilitate diversion or groundwater pumping for new uses.

Q: Have you worked with augmentation plans?

A: Yes; a significant aspect of the work by our firm in Colorado is the development and implementation of augmentation plans. This often involves the analysis of stream depletions caused by groundwater pumping and quantification of the replacement supply, based on changes of use and physical availability.

Q: Are there similarities between augmentation plans you have worked on and a Plan to assist with compact compliance pursuant to the FSS?

A: Yes; the principles are similar. A water supply is provided that is not otherwise available to supplement streamflow and offset stream depletions caused by the project proponent. This is, in effect, a replacement supply of water. Such plans require measurement and accounting to ensure that the replacement is sufficient. For a plan to operate successfully, the replacement supply must be managed to offset the impacts being replaced. An important aspect of such plans is

documentation and monitoring the operation of deliveries and quantification of credit. The plans anticipated under the FSS would most likely rely on groundwater pumped to the stream. In the case of the FSS, it is necessary to integrate the augmentation supply into the compact accounting for water supply, allocation and use.

Offer As An Expert

The State of Kansas offers Mr. Book as an expert in the areas of water resources engineering, water rights engineering, hydrology, hydrologic modeling and irrigation engineering.

Q: What was your general assignment from Kansas for this project?

A: I was asked to review the proposal from the State of Nebraska to the RRCA for approval of an augmentation plan, referred to as the N-CORPE Augmentation Project. Based on my familiarity with the Republican River Compact, the FSS and the Accounting Procedures, and augmentation plans in general, I was requested to evaluate the potential impacts to Kansas of implementing the N-CORPE Project and to develop opinions concerning the adequacy of the proposal.

Q: Would you describe your review and analysis?

A: I reviewed the documents submitted by Nebraska on June 10, 2013 related to the Project. I compiled information from the RRCA compact accounting, and streamflow data on Medicine Creek and reservoir storage data.

Q: What is an augmentation plan, in the context of the Republican River Compact?

A: Under the provision of subsection III.B.1.k of the FSS, augmentation plans are described as wells acquired or constructed by a state for the sole purpose of offsetting stream depletions in order to comply with its compact allocations. Such Plans are to be approved by the RRCA.

Q: Would you provide a brief description of the N-CORPE Augmentation Project?

A: The N-CORPE Project will consist of approximately 30 new wells located in Lincoln County near North Platte, Nebraska. The wells are located along the basin divide between the Republican and Platte River basins. The water will be delivered to the headwaters of Medicine Creek, approximately 6 miles from the well field. This location is approximately 76 miles upstream of the dam on Harry Strunk Reservoir. EX. NCORPE K107 is a map showing the location of the project and Medicine Creek within the basin in Nebraska. The project has a design capacity of 60,000 acre-feet/yr. Water may be delivered to either of the two basins, although plans for the Platte River operations are not developed yet. The Nebraska proposal is to receive credit in the compact accounting for the full amount of the discharge to Medicine Creek, less some adjustment for computed new depletions that would be subtracted. This adjustment to the augmentation credit in the accounting was not disclosed until the responsive report submitted by Nebraska on February 7. The amount of pumping in any year will be at the discretion of the Nebraska NRDs.

Q: What elements of the Plan did you review for this analysis?

A: I reviewed the proposal to the RRCA for impacts to the State of Kansas that would be caused by the proposed operation and accounting.

Q: Did you prepare a report for this proceeding?

A: Yes; I prepared a report, submitted on January 24, 2014, (Ex. NCORPE K104).

Q: Would you describe generally the content of the report?

A: The report includes an introductory section, a summary of my opinions concerning this plan, and a summary of my experience and qualifications. The report also contains sections describing the project features and hydrologic data, the bases for my opinions concerning determination of the augmentation credit and effect of transit loss on the compact accounting.

Q: Why are changes to Compact Accounting Procedures necessary for an augmentation plan?

A: An augmentation plan is intended to produce supplemental streamflow from a source that would not otherwise contribute to streamflow to offset stream depletions in order to comply with a State's compact allocation. A plan relying on groundwater produces new streamflow by removing water from aquifer storage and discharging to the stream system. Because the pumping is from the aquifer hydraulically connected to the streams, streamflow depletion also results from the pumping, but normally at a rate less than the pumping rate. Therefore, it is appropriate to include augmentation supply, to the extent it adds to streamflow, as a credit in the compact accounting for the water supply of the basin, so long as the depletive pumping effects are also included as stream depletions charged against the compact allocation.

Q: Why is it inappropriate to provide credit for all of the water discharged from the augmentation pipeline?

A: The actual contribution to streamflow will reflect loss in the stream system, referred to as transit loss. It is necessary to account for this reduction of flow when determining the amount of credit for offsetting stream depletion in the compact accounting. Otherwise the amount of offset would be overstated.

Q: Would you describe the location of the pipeline discharge?

A: The discharge point is located northwest of Wellfleet, in an area in sandhills with flat terrain. There is some irrigated cropland surrounding the discharge site. Nebraska indicated that live streamflow in Medicine Creek likely begins about two miles southeast of the discharge point. The first location where a recent measurement was made is about five and one-half miles southeast, where 1.6 cfs was measured. The location of the discharge point at the headwater of a stream, upstream of perennial flow, is likely to affect seepage conditions.

Q: Would you provide an overview of your opinions regarding the N-CORPE Augmentation Plan, as proposed by the State of Nebraska?

A: 1.) The accounting for computed augmentation credit, as proposed without adjusting for transit loss, would result in the reduction of allocated supply to the State of Kansas. 2.) The comparison of augmentation discharge to surface water consumptive use (CBCU) in the Accounting Procedures does not justify providing augmentation credit for the full amount of the discharge, unadjusted for transit loss. 3.) The proposal has the potential to increase reservoir evaporation charges to the State of Kansas, unless terms and conditions are included to

prevent this impact. These opinions are stated with more detail on page 3 of my report.

Q: Would you describe the availability of streamflow records on Medicine Creek?

A: There are two streamflow gages currently in operation on Medicine Creek; the first is located upstream of Harry Strunk Reservoir about 15 miles and the second is just downstream of the reservoir, and serves as the accounting gage for the Medicine Creek sub-basin. The flow data are summarized in my report in Tables 1 and 2. Average annual flow upstream of the reservoir has been 43,083 acre-feet/yr. (60 cfs). Flows have been less in more recent years. Figure 2 in the report plots the annual flows and monthly distribution of the average. Measurements were made by Nebraska DNR at six locations along Medicine Creek between the discharge location and Stockville, several miles upstream of the upstream gage. These measurements were made January 21 and 27, 2014 and provided to Kansas on February 7th. There are not significant surface water diversions from Medicine Creek upstream of the reservoir. (Pump depletions on Medicine Creek averaged less than 300 acre-feet/year for 2002 – 2006.)

Q: Does the Nebraska accounting proposal contain a mechanism to account for transit loss to augmentation discharge?

A: No.

Q: Would you define what you mean by transit loss?

A: When flow is discharged to the stream, some of the flow will be lost in transit downstream, such that the increased flow downstream will be less than the

amount of the discharge to the stream. Transit loss can be temporary or long-term and includes accruals to aquifer storage, ET in the stream corridor and bank storage. Bank storage tends to be temporary in nature if discharges are for limited periods of time. However, some loss would accrue to aquifer storage, and not return to the stream after the discharge is discontinued. Increased ET is a permanent loss from the system. If augmentation credit is provided for the full amount of the discharge, without regard for the increase in streamflow that occurs downstream, then credit to offset depletions would include some water that is lost to ET or accrues to aquifer storage. These two categories are inappropriate to consider as offsetting stream depletions because they do not increase the water supply.

Q: Is there an effect of including transit loss as credit?

A: Yes. This is best illustrated by considering the calculation of the VWS with the gage data in a sub-basin. The Augmentation Water Supply (AWS) would be subtracted from the gaged flow, leaving the remaining flow for inclusion in the calculation of VWS and allocations to the states for the sub-basin. The allocation of Medicine Creek supply is effectively split as 54% to Nebraska, and 46% to Kansas. Colorado has no allocation on Medicine Creek or the mainstem of the Republican River, and therefore is unaffected by this proposal. The effect of including transit loss as credit is to reduce the natural flow used in the water supply calculation and, as a result, reduce the computed allocations. Although the Nebraska allocation is reduced by a fraction of the transit loss, it receives a credit for more AWS than reaches the accounting point; in other words, the

increase in CBCU allowed would include some water that is consumed by ET or accrues to aquifer storage.

Q: Would you describe what is illustrated on your report Table 3?

A: Table 3 illustrates the effect on the Kansas allocation with an example that assumes transit loss of 10% of the augmentation discharge in the Medicine Creek sub-basin. The gage flow increases by 90% of the 60,000 acre-foot discharge, or by 54,000 acre-feet. The credit applied in the accounting is for the full 60,000, as contained in the current proposal. (Some slight reduction might be made depending on whether new net depletions are being calculated under the modified proposal, but this is expected to be relatively small.) The table shows the Nebraska statewide allocation, CBCU, IWS credit and accounting balance for the years 2002 – 2006. The negative balance indicates CBCU in excess of allocation, after offsetting with the IWS credit. As proposed, the AWS credit would be applied in the accounting computationally the same as IWS credit; that is, deducted from the sub-basin gage to compute the supply and allocations and applied as a credit against CBCU. The AWS does not increase the allocation, but offsets CBCU that is in excess of the allocation. In this case, with this amount of credit, the result is to reduce CBCU below the allocation with the offset. The allocation is reduced with this accounting proposal, by 3,210 acre-feet for Nebraska and 2,790 acre-feet for Kansas. However, Nebraska receives an offset credit for 60,000 acre-feet, which is 6,000 acre-feet more than the increased supply at the accounting gage. This example is limited to the Medicine

Creek sub-basin and does not analyze any effect on the mainstem net gain and resulting change in allocation.

Q: Is this result appropriate?

A: No. This would result in augmentation credit to offset Nebraska stream depletions that would include, in part, ET and accrual to aquifer storage. The computed natural supply of the sub-basin would be reduced due to the assumption that all of the augmentation discharge is subtracted from the gaged flow as credit, thereby reducing the allocations. This result is not appropriate. The accounting procedures very clearly limit the groundwater depletions charged to a State to the depletion of streamflow. Pumping effects that would derive from aquifer storage or result in ET are not charged as CBCU. Similarly, any IWS that is lost in transit to an accounting point is excluded from the IWS credit and the credit is only the amount of increased flow at the accounting points.

Q: Is there an impact on the mainstem of the Republican River as well?

A: Yes; the impact on the mainstem of increased flow due to augmentation supply is to increase the loss along the mainstem, reducing the net gain to the mainstem supply in the accounting. It is necessary to also account for this component of loss to avoid the impact of reducing the computed water supply and Kansas allocation with the augmentation credit. This is consistent with the way the IWS credit is computed in the accounting. It is appropriate to apply the same logic to crediting for AWS to avoid the impact of reducing Kansas' allocation.

Q: What would be the effect of allowing credit for all of the augmentation discharge in the compact accounting?

A: The allocation to the State of Kansas would be reduced to something less than it would have been without the augmentation supply.

Q: Does Nebraska contend that the RRCA surface water accounting procedures require that transit loss from augmentation be disregarded?

A: Yes.

Q: Would you summarize your opinion regarding this assertion?

A: Yes. This implies a quantitative tradeoff between credit for augmentation supply that is provided and surface water diversions that are allowed to continue. This would be a comparison of a hypothetical condition for surface water not being diverted and the actual condition on the stream of providing augmentation supply. The Compact provides that the VWS and allocations are the based on the combination of streamflow at the downstream locations (sub-basins or at state lines) and consumptive use (Computed Beneficial Consumptive Use (CBCU)). These two elements form the basis to compute the VWS, and in accordance with the FSS, the CWS. The discharge of augmentation supply at the upper reaches of the basin in the headwaters of tributaries does not compensate for CBCU located much further downstream in the basin one for one. Table 4 of my report summarizes the CBCU in Nebraska for the years 2002 – 2006. These are expected to be the types of years for which this project would be operated as an augmentation supply for the Republican Basin. GW CBCU constituted 80% of the statewide total for Nebraska over this period. The surface water CBCU for this period included about 8% reservoir evaporation and 8% from the federal project canals. Other surface water use constituted another 4%

of the total. Surface water use in future dry periods is expected to be less than over this period. The losses should not be ignored for two reasons: 1.) The location of the surface water use in the basin is much lower in the basin than the augmentation supply discharged into the headwaters above the live flow of the streams, in this case Medicine Creek. 2.) Most of the CBCU in Nebraska is due to groundwater depletion, which is computed with the model to account for the net effect at specified accounting points. It should also be noted that the FSS does not prohibit accounting for augmentation supply at specific locations like the pumping and IWS credits are computed at. It is reasonable to conclude that the RRCA consideration of the actual effect augmentation supply would include protection of the VWS to the condition without augmentation, which would include impacts along the mainstem of the Republican as well as the sub-basin supply.

Q: Did Dr. Schneider state an opinion regarding the comparison of the location of surface water CBCU in Nebraska with the N-CORPE project?

A: Yes. At page 3 of the February 7, 2014 report he noted that there are surface water depletions upstream in the basin for which Nebraska does not receive a "transit loss discount". The FSS does not prohibit accounting for transit loss on augmentation water supply. CBCU is determined as established in the Accounting Procedures and becomes part of the computed virgin water supply to be allocated. I provided a summary of the surface water CBCU in Nebraska for the period of 2002 – 2006 in Table 4 of my report. Ex. NCORPE K108 is a graphical illustration of the relative location of the surface water CBCU and the N-

CORPE project, expressed in stream miles. The reference point is the dam at Harlan County Reservoir. For example, the Haigler Canal is located at the Colorado-Nebraska stateline, just over 200 miles upstream. The next furthest location is at Enders Reservoir, 200 miles upstream, where the reservoir evaporation occurs. The N-CORPE project is located 165 miles upstream on Medicine Creek. The surface water CBCU displayed is the cumulative total progressing from upstream to downstream. For example, the accumulated CBCU at 70 miles upstream is 30,000 acre-feet/yr. This is at the Cambridge Canal just downstream of Medicine Creek on the Republican River. The accumulated CBCU at Harlan County Reservoir was slightly more than 42,600 acre-feet/yr. Surface water pumps are not included in this total. It is my opinion that there is not a close correspondence between the amounts or locations of surface water CBCU in Nebraska and the N-CORPE Project that would justify offsetting transit loss by application of a "transit loss discount" if surface water CBCU were to be hypothetically eliminated.

Q: Would you summarize your opinion regarding reservoir operation with augmentation supply?

A: Yes. This issue is related to the assessment of evaporation at Harlan County Reservoir. Kansas is allocated a certain percentage of the evaporation, calculated each year based on use of the water supply. To the extent that the augmentation water is accumulated at Harlan County Reservoir and reserved for later release, it has the potential to increase the evaporation charge. If this occurs without Kansas having access to the storage, or results in additional

water that is carried over beyond what would have been available with compliance, then the allocation of evaporation should not result in an additional charge to the State of Kansas. Terms and conditions should be developed to avoid this potential impact.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjurty that the foregoing is true and correct.

Executed on February 24, 2014.