Non-Binding Arbitration initiated July 10, 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

Nebraska N-CORPE Augmentation Plan

Republican River Compact

Response to proposal from State of Nebraska, dated June 10, 2013

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TABLE OF CONTENTS

1. Introduction

The State of Nebraska submitted a request to the Republican River Compact Administration (RRCA) for approval of the N-CORPE augmentation plan on June 10, 2013. This project will pump groundwater to the Republican River Basin in the headwaters of Medicine Creek. Approximately 30 new wells will be developed to produce up to 60,000 ac-ft/yr. The augmentation pumping project (Project) is currently planned as a joint cooperative program to deliver water to both the Republican and Platte River Basins. One of the cooperating entities is the Twin Platte NRD. The Project would provide augmentation credit for the State of Nebraska towards compliance with the Republican River Compact because the water pumped and discharged would exceed the depletions to Republican River flows created by the pumping. There will be retirement of irrigated lands associated with the Project.

The State of Nebraska is proposing an augmentation credit for the full amount of the pipeline discharge to the headwaters of Medicine Creek, to offset computed Beneficial Consumptive Use (CBCU) in the basin. The effect of the credit is to increase the amount of CBCU, or stream depletion that can occur within Nebraska beyond Nebraska's allocation under the Compact. The effect is essentially the same as for the Imported Water Supply Credit (IWS), in that the quantity of the credit is deducted from the gaged flow for determination of the allocable water supply[1]. For testing compliance with Nebraska's compact allocation, the credit is subtracted from the CBCU.

The Final Settlement Stipulation (FSS) references augmentation plans in subsection III.B.1.k, listing exceptions to the moratorium, and subsection IV.A, referring to determination of augmentation credit based on the methodologies in the Accounting Procedures. At the time of the Nebraska submittal to the RRCA, the Accounting Procedures did not include procedures to determine augmentation credit. Since that time, a one-year approval for augmentation credits has been approved for Colorado's CCP project, which delivers water to the Republican River (North Fork) at the Colorado-Nebraska Stateline.

2. Project Description

The N-CORPE Project will consist of new wells, interconnected by pipes, and pipelines to deliver the pumped water to streams in Lincoln County. The wells and pipeline to Medicine Creek are located in the vicinity of North Platte, Nebraska. The Medicine Creek pipeline will extend approximately six miles south from the wells to the headwater of Medicine Creek. The pipeline discharge will be located approximately 76 stream miles upstream of the dam on Harry Strunk Reservoir. The Project location is shown on Figure 1, a map of the Republican River Basin in Nebraska.

[1] The allocable water supply under the FSS is the Computed Water Supply. In basins without federal reservoirs, the CWS is essentially equivalent to the VWS.

The Project is expected to deliver some of the yield to the Platte River to address obligations of the State of Nebraska in the Platte River Recovery Implementation Program. Details about how deliveries to the two basins would be coordinated are not provided. The wells to be pumped are located at the Platte/Republican Basin divide. An annual limit on the amount of pumping and augmentation credit, as calculated by Nebraska's proposal, was testified to by Dr. Schneider, corresponding to the design capacity of the Project to deliver 60,000 ac-ft/yr to the Republican Basin.

The Nebraska proposal is to apply the full amount of the discharge from the pipeline into the Republican Basin as an augmentation credit in the annual compact compliance accounting. The proposed modification to the accounting procedures would adjust the Medicine Creek gaged flow for the purpose of computing the VWS, CWS and allocations. The augmentation credit is also subtracted from Nebraska CBCU in the compliance tables. Depletions to streamflow caused by pumping the augmentation wells would be included within the pumping impacts determined for Nebraska pumping by with the RRCA Groundwater Model.

The use of the Project will be at the discretion of the NRDs. The proposal describes two modes of operation; Compact operation years and state-based operations. The compact operation years would correspond to years when Nebraska DNR and the NRDs project that augmentation would be necessary to avoid or limit reductions in use while achieving compact compliance. State-based operations would be anticipated for "offsetting any new depletions that occur outside of Compact Operation Years" (pg. 7, June, 2013). The proposal does not indicate that pumping would be limited to amounts of projected shortfall from the accounting made pursuant to the Integrated Management Plans. It is possible that augmentation pumping and delivery to Medicine Creek could be made to accumulate credits in years not determined to be compact operation years or to increase the storage in Harlan County Reservoir to assist with avoiding water short years.

Streamflow records for Medicine Creek have been summarized in Tables 1 and 2. A streamflow gage is located approximately 15 miles upstream of the dam at Harry Strunk Reservoir. Table 1-A shows the monthly streamflow. Average annual streamflow has been 43,000 ac-ft/yr, or approximately 60 cfs. This is one of the stream gages for which the baseflow was computed for the Groundwater Model development. Table 1-B shows the monthly baseflow derived from that analysis. The baseflow quantified through year 2000 averaged 47 cfs, or 77 % of the total flow at the site. The Medicine Creek streamflow is displayed graphically on Figure 2. The magnitude of the proposed augmentation supply is illustrated on Figure 2 by adding the approximate amount of annual discharge to the historical streamflow. Adding 60,000 ac-ft. to Medicine Creek would approximately double the streamflow, based on historical record.

The other stream gage with significant record is located just downstream of Harry Strunk Reservoir. This gage is used for RRCA Compact accounting and reflects streamflow affected by reservoir operations. Streamflow at this gage is summarized in Table 2.

3. Summary of Opinions

1. The Nebraska proposal would result in a reduction to the Kansas allocation of VWS. This would be caused by quantifying augmentation credit as the full amount of the discharge for the calculation of Computed Water Supply for the Medicine Creek sub-basin. The streamflow at the compact accounting gage will not be increased in the same amount as the augmentation discharge upstream. Credit should be reduced for losses that will occur in transit from the discharge point downstream to Harlan county Reservoir.

2. The comparison of augmentation well discharge to surface water consumptive use in the accounting procedures as a basis to omit adjustment to the augmentation credit for transit loss is inappropriate for this augmentation plan.

3. The Nebraska proposal has the potential to increase the storage content in Harlan County reservoir, thereby increasing the evaporation charges assessed against the State of Kansas, if appropriate accounting adjustments are not made.

4. Transit Loss

The proposal would assign the full amount of the water discharged from the pipeline as credit in the RRCA accounting. Losses attributed to the augmentation discharge are likely to occur. This will result in the flow at the mouth of Medicine Creek increasing by less than the amount of the augmentation discharge. No accounting, measurement or other determination of losses in transit are currently proposed. Neither the State of Nebraska nor the project sponsors plan to install stream gages to monitor deliveries down Medicine Creek. The location of the Project in the basin is such that transit losses are likely between the discharge point and the accounting point downstream on Medicine Creek.

A credit for the full amount of the discharge would result in Nebraska receiving augmentation credit for some water that ultimately accrues to aquifer storage in Nebraska, as well as some loss to ET (Larson & Perkins, Jan. 24, 2014). This has the effect under the proposed accounting of both reducing the computed VWS, CWS and resulting allocations, as well providing a credit to Nebraska beyond the amount actually delivered. This has a negative effect only on the State of Kansas, since the effect on Nebraska is to replace reduced allocation with augmentation credit. The allocation and compact compliance of the State of Colorado are unaffected. To avoid negative impact on the State of Kansas, it would be necessary to exclude transit losses from the augmentation credit. This would also necessitate accounting for the losses below Medicine Creek on the mainstem of the Republican River. Accounting for the impacts of augmentation discharge downstream would be consistent with the methodology used for quantification of both the Groundwater depletions and IWS credit in the Compact Accounting.

The effect of providing augmentation credit is to allow Nebraska CBCU to increase above its allocation by the amount of the credit. When the allocation is reduced due to transit loss that does not reach the compact accounting gage, then Nebraska CBCU is allowed to increase by the amount of the credit, less the reduction of allocation. The Kansas allocation is also reduced, by 46% of the amount of transit loss. The net additional Nebraska CBCU that would be allowed with the augmentation credit would exceed the increased supply at the accounting point by 46% of the transit loss. The reduction in Kansas allocation is 46% of the loss, transferred to allowable Nebraska CBCU.

Augmentation credit is subtracted from gaged flow to compute the CWS and allocations. The proposed accounting would assume all of the augmentation discharge reaches the Medicine Creek accounting gage. To the extent the streamflow has not increased by the amount assumed to reach it, the supply and allocation are reduced below what would have occurred without the augmentation flow. Table 3 was prepared to illustrate how the proposed accounting would affect the State of Kansas when the credit is not adjusted to remove transit loss. The analysis assumes that the loss from the augmentation pipeline to the Medicine Creek accounting gage is 10% and that no further loss occurs downstream on the Republican River. The augmentation discharge is 60,000 ac-ft/ yr for the five years 2002 – 2006 and the increased flow at the gage is 54,000 ac-ft/yr.

Assuming a 10% transit loss from the outfall to the gage, Table 3 shows the reduction to the Nebraska and Kansas compact allocation. The Kansas allocation would be reduced by 2,790 ac-ft in a year with 60,000 ac-ft of augmentation discharge and an increase of 90% (54,000 ac-ft) of this amount at the Medicine Creek accounting gage. The amount of CBCU available to the State of Nebraska would be increased by 56,790, ac-ft, which would be 2,790 ac-ft more than reached the accounting point.

Nebraska's compliance balance improves by the amount of the credit, less the reduction in allocation. This is more than the amount of augmentation reaching the accounting point, by an amount equal to the reduction in Kansas allocation; or 2,790 ac-ft in a year when the discharge is 60,000 ac-ft and the amount of loss above the gage is 10%.

Additional reductions to the Kansas allocation would occur due to losses downstream of Medicine Creek along the mainstem. The mainstem supply is computed in the accounting as the net gain below the compact subbasins. As losses are increased along the mainstem, the net gain is reduced, having the same effect on the Kansas' mainstem allocation as described above for the sub-basin supply.

In conclusion, by assuming that all of the pipeline discharge is credit in the accounting, the calculated CWS is reduced, therefore reducing Kansas' allocation below what it would have been without the augmentation discharge. However, if the transit loss were deducted from the credit, the CWS to be allocated would reflect the quantity available without the augmentation.

The increased Nebraska CBCU allowed would be the amount of the augmentation supply at the accounting points, and there would be no change in Kansas allocation.

5. Surface Water Accounting

The recommendation by Nebraska that the augmentation credit should be equal to the full amount of the pipeline discharge is based in part on a conclusion that the Compact Accounting for Surface Water diversions and return flows does not account for any loss or reduction that might occur if the water were to be left in the stream undiverted. This comparison is not a valid basis to omit adjustment of the augmentation credit for transit loss on augmentation deliveries for two reasons.

- The location of surface water CBCU is much lower in the basin than the locations of augmentation discharge currently proposed.
- Most of the Nebraska CBCU is attributable to Groundwater depletion, which is computed at accounting points in the basin, excluding changes in aquifer storage and stream ET upstream of the accounting locations from the depletions charged to Nebraska.

The location of surface water consumptive use in the basin is predominately attributable to the Reclamation Project canals and reservoirs generally located along the mainstem of the Republican River (See Figure 1). Also shown on Figure 1 are the locations of the N-CORPE and Rock Creek augmentation Projects. These are located much higher in the basin than the surface water projects.

The amount of Nebraska CBCU attributable to surface water use is significantly less than the Groundwater CBCU, and is located relatively lower in the basin. Table 4 is a summary of the Nebraska Surface Water and Groundwater CBCU for the years of low water supply, (2002 – 2006) which would correspond to years when the Project is expected to be pumped for augmentation. The annual surface water CBCU in Nebraska averaged 51,300 ac-ft/yr, or 20 % of the total statewide CBCU, ranging from 32 % in 2002 to 13% in 2006. Reservoir evaporation made up less than half of the total surface water CBCU in these years. The federal projects accounted for about 82 % of the total surface water CBCU. The relative amount of surface water CBCU during dry periods is expected to be less in subsequent years due to the restrictions imposed during Compact Call years.

A more reasonable comparison to augmentation credit in the current Accounting Procedures is with the IWS credit, which is determined with the RRCA Groundwater Model at set accounting points agreed to in the FSS. The location of the augmentation projects is more comparable to the source of the IWS in the basin. The credits to offset CBCU should reflect actual accruals in the basin at accounting points consistent with the current Accounting Procedures.

As noted above, the surface water use is generally along the Republican River. If the augmentation credits were to be considered as offsets only for surface water diversions in the

basin, it would be necessary to require a much closer correspondence between the location of augmentation credits and surface water diversions. As illustrated on Figure 1, this would require at a minimum that the credits be limited to actual deliveries from the sub-basins to the mainstem of the Republican River. However, the Groundwater depletions and IWS credits in the basin are translated all the way down the river to Harlan County Reservoir. Losses due to additional flow downstream of Medicine Creek are likely to occur.

6. Reservoir Operations

The project will increase inflows at Harry Strunk Reservoir. Nebraska has not identified how this water would be administered in the basin, but it is assumed for purposes of this review that it would be passed through Harry Strunk at the time it is discharged. Records of storage content at Harry Strunk for the period 2000 - 2012 are shown on Figure 3. These records support the observation that upstream augmentation discharge would not likely increase the level of storage, at least annually, at Harry Strunk. The reservoir has filled to conservation capacity in most years.

It should be noted that if additional water were accumulated into storage in a given year the CWS would be inappropriately reduced if all of the augmentation discharge were assumed to reach the Medicine Creek gage. This would further change the allocations from the condition with no augmentation, reducing Kansas allocation in years when augmentation is provided.

There are several alternatives for administration of augmentation flow at Harlan County Reservoir. The Plan submittal does not address this issue. Reservoir storage data are provided on Figure 4 for the period 2000 - 2012. During years of low supply, storage in the reservoir did not reach conservation capacity. Augmentation water flowing into Harlan County Reservoir could be stored as part of the natural flow, stored and separately held and accounted for in the reservoir or passed downstream. If additional storage is accrued, additional evaporation is increased, a portion of which is charged to the State of Kansas.

To the extent that additional storage would reflect conditions that would have existed with Nebraska in compliance with the compact, it may be reasonable for evaporation to be allocated between the two states in accordance with the FSS. However, to the extent that additional water is stored or stored water is unavailable or unneeded by KBID in a given year, holding the water in Harlan County Reservoir should not result in a charge to the State of Kansas. Terms and conditions should be developed to avoid this potential impact.

7. Qualifications

I am a consulting civil engineer, specializing in water resources, water rights engineering, water supply and hydrology. I have both a Bachelors and a Masters degree in Civil Engineering, specializing in water resource engineering. I am a professional engineer registered in six states. I am president of the firm Spronk Water Engineers, located in Denver, Colorado. I have testified

as an expert witness in matters related to water rights transfers and plans for augmentation, as well as in interstate water cases.

I have been involved with the Republican River Compact as an engineering consultant to the State of Kansas for approximately 20 years. During that time I have undertaken hydrologic investigations of the Republican River Basin related to matters of compact compliance. I participated in the settlement negotiations leading up to the adoption of the FSS. I was involved in the development of the Accounting Procedures and Reporting Requirements adopted by the RRCA to implement the provisions of the settlement. I was a member of the Technical Committee that developed the RRCA groundwater model. I am familiar with the calculations of Beneficial Consumptive Use that are developed annually for administration of the Compact. I have investigated and reviewed potential alternatives for Nebraska and Colorado to achieve compact compliance subsequent to the adoption of the FSS. I am familiar with the operation of the federal reservoir projects in the Republican River Basin and the relationship of ground and surface water use in the basin. I have testified as an expert witness in four previous arbitration proceedings and at the trial in Kansas v. Nebraska & Colorado.

As a water resources and water rights consultant, I assist a variety of clients in evaluation and development of water supplies throughout the western United States, within the prior appropriation system. An important element of this process is the acquisition and transfer of water rights for new uses. I have more than 30 years of experience in consulting on water rights matters, including water transfers, plans for augmentation, use of water from federal projects, and administration of interstate compacts.

My technical specializations include river basin modeling, hydrologic investigations, evaluation of irrigation systems and the interaction of ground and surface water flow. I participated in the development of the Arkansas River model currently being used for assessing compliance with the Arkansas River Compact. This model includes reservoirs and canal systems covering a reach of 150 miles. The model simulates diversions, storage, irrigation and stream-aquifer interaction. I currently participate in the annual updates of this model. Significant issues involved with this modeling have included irrigation practices, groundwater pumping measurement and estimation, reservoir operations, crop evapotranspiration and model calibration. I have also worked on models in the Colorado River, Gunnison River, and Rio Grande in New Mexico.

I have developed and completed plans for augmentation in Colorado which involve development of groundwater supplies and changes of senior surface water rights. This process requires investigations to determine historical consumptive use and impacts to streamflow of senior water rights and effects caused by well pumping on streamflows. Changed uses of water rights are conditioned to prevent expanded use by balancing historical consumptive use and return flows with pumping depletions.

8. References

- Nebraska Department of Natural Resources, N-CORPE Augmentation Project; Submittal to RRCA, June 10, 2013

- Larson, Steven P. and Perkins, Samual P., Report on the Nebraska N-CORPE Augmentation Plan, Response to Report Prepared by State of Nebraska, January 24, 2014

- Final Settlement Stipulation, December 15, 2002, Vol. 1-5, Kansas v. Nebraska & Colorado No. 126, Orig., U.S. Supreme Court

- Arbitrator's Final Decision, In non-binding Arbitration pursuant to the Final Settlement Stipulation, Kansas v. Nebraska & Colorado No. 126, Orig., U.S. Supreme Court, Nebraska's Alternative Water-Short Year Plan and Nebraska's Rock Creek Augmentation Plan, November 25, 2013.

- Deposition of Dr. James Schneider, January 14, 2014.

TABLES

Table - 1A

Total Streamflow - Medicine Creek above Harry Strunk Lake, Ne (6841000)
(values in ac-ft)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1951	3,094	3,527	3,443	3,285	3,822	3,749	5,413	21,069	22,011	9,719	4,017	9,051	92,199
1952	3,753	3,763	3,675	3,497	3,882	5,726	3,933	3,850	2,541	3,114	3,279	2,214	43,226
1953	2,836	3,033	3,328	3,939	3,479	4,076	3,630	3,517	2,462	3,231	2,825	1,710	38,065
1954	2,717	3,554	3,616	3,558	3,921	3,673	3,346	5,510	3,164	1,569	3,314	1,714	39,658
1955	2,795	3,049	3,350	3,624	3,620	4,280	3,350	4,604	4,552	1,623	1,254	1,490	37,589
1956	2,491	2,828	2,826	2,979	3,346	3,953	3,763	4,134	2,680	6,653	2,529	1,621	39,803
1957	2,180	3,253	3,265	2,630	3,090	3,858	5,861	18,776	5,467	7,952	2,987	4,017	63,335
1958	3,180	3,479	3,556	3,556	3,340	4,937	4,600	4,173	3,588	7,375	2,882	3,130	47,796
1959	2,844	3,382	3,753	3,449	3,295	4,388	3,808	6,377	3,084	2,184	1,803	2,166	40,533
1960	3,374	3,378	3,673	3,654	11,123	22,784	4,276	5,548	6,220	2,753	1,801	1,787	70,373
1961	2,832	3,076	3,654	3,003	3,564	4,296	3,971	5,522	3,376	2,325	1,720	2,071	39,410
1962	2,785	3,199	3,225	3,066	3,360	4,687	3,505	7,676	25,787	21,412	7,994	3,499	90,196
1963	3,854	3,707	3,707	3,701	6,984	4,467	3,717	3,671	9,196	3,305	1,837	4,669	52,815
1964	3,130	3,437	3,130	3,610	3,548	4,316	6,012	3,422	6,579	2,400	2,039	2,682	44,305
1965	2,795	2,951	3,761	3,572	3,221	3,709	4,687	5,492	6,883	3,864	2,702	4,147	47,784
1966	4,066	3,533	3,834	3,299	6,714	4,584	3,983	3,503	3,426	4,116	7,504	3,045	51,605
1967	3,370	3,675	3,543	3,691	3,622	3,985	3,572	3,846	18,127	9,249	2,368	4,195	63,244
1968	3,207	3,529	3,380	3,729	3,721	4,019	4,324	3,957	4,875	2,321	4,036	2,231	43,330
1969	2,949	3,176	3,223	3,787	3,604	4,939	3,681	3,556	21,971	7,960	2,600	2,828	64,275
1970	3,937	3,798	3,838	3,785	3,681	4,173	4,019	3,382	3,939	1,940	1,553	1,946	39,991
1971	2,965	3,447	3,457	3,610	3,921	4,235	3,963	4,302	3,687	2,959	2,628	2,214	41,390
1972	3,461	3,493	3,473	3,170	3,346	3,967	3,632	4,635	3,999	2,309	2,418	2,247	40,150
1973	2,890	3,469	2,797	3,600	3,846	4,318	4,203	5,782	3,074	3,529	2,612	2,870	42,990
1974	3,265	3,495	3,342	3,818	3,537	3,949	3,777	3,402	3,826	1,478	1,611	1,863	37,361
1975	2,769	3,102	2,977	3,566	2,967	3,896	3,765	3,346	10,134	2,531	1,809	1,863	42,725
1976	2,543	2,547	3,781	3,675	3,628	3,794	3,705	3,862	3,106	2,263	1,722	1,870	36,496
1977	2,608	2,779	2,858	2,350	3,130	4,413	6,002	6,879	3,348	2,037	2,384	2,172	40,961
1978	2,767	2,965	3,152	2,444	3,517	11,385	4,431	3,898	2,684	1,704	1,345	1,335	41,626
1979	2,180	2,805	2,735	2,366	7,506	5,439	3,658	3,249	3,830	10,534	5,332	2,303	51,936
1980	2,644	3,068	3,414	3,172	6,877	4,132	4,068	3,306	2,588	1,240	1,146	1,569	37,224
1981	2,134	2,588	2,969	3,021	2,704	3,737	3,320	3,705	2,452	5,905	7,006	2,356	41,897
1982	2,497	2,957	3,245	2,465	3,108	3,840	3,308	4,040	3,965	2,392	2,325	1,991	36,135
1983	2,688	3,065	3,098	3,461	3,362	4,056	3,523	4,354	3,293	2,083	1,523	1,416	35,921
1984	2,585	2,823	3,086	3,467	3,457	3,396	3,997	4,564	4,370	5,082	1,678	1,603	40,106
1985	2,858	2,856	3,021	3,072	3,796	3,186	3,717	4,211	2,644	2,182	1,684	1,993	35,221
1986	2,866	2,660	2,719	3,408	3,267	3,352	3,162	3,092	3,453	1,837	1,279	1,676	32,771
1987	2,380	2,585	2,834	2,965	3,094	3,654	3,253	2,955	3,461	2,987	1,535	1,628	33,333
1988	2,436	3,118	2,707	3,061	5,199	3,362	3,098	3,344	1,985	1,997	5,256	1,954	37,518
1989	2,388	2,571	2,866	3,066	3,037	3,479	2,785	2,682	3,420	1,813	3,237	2,124	33,468
1990	2,350	2,652	3,015	3,180	2,848	3,487	2,936	3,168	2,632	1,162	2,688	1,200	31,317
1991	2,095	2,592	2,686	2,987	2,936	3,108	3,035	5,338	3,588	1,507	1,252	1,351	32,474
1992	2,053	2,622	2,787	2,965	2,922	3,326	2,717	2,440	2,489	2,214	4,086	2,089	32,710
1993	2,527	2,717	3,019	3,066	3,824	7,281	3,574	3,866	5,020	14,575	4,798	4,304	58,573
1994	3,646	3,779	3,826	3,878	3,985	5,173	3,858	3,727	2,594	2,452	2,114	1,924	40,955
1995	2,767	2,904	3,261	3,364	3,029	3,491	3,669	4,193	3,588	2,166	1,301	1,660	35,394
1996	2,509	2,711	2,987	2,797	2,805	3,362	3,271	3,806	3,917	4,401	3,144	4,245	39,956
1997	3,098	3,132	3,140	2,672	3,491	3,777	3,541	3,305	5,869	2,545	2,600	2,372	39,541
1998	3,628	3,253	3,463	3,548	3,439	3,624	3,414	4,790	3,132	2,283	1,902	1,414	37,891
1999	2,398	2,965	2,817	3,174	3,059	3,406	3,701	3,610	4,074	2,051	3,616	2,128	36,998
2000	2,590	2,770	2,830	2,960	3,060	3,380	3,000	2,890	1,820	2,280	2,580	1,310	31,470
2001	2,280	2,670	2,640	2,840	2,570	4,340	3,920	3,350	2,230	1,800	1,990	1,900	32,530
2002	2,390	2,440	2,710	2,660	2,680	3,290	2,780	2,600	1,660	819	697	862	25,588
2003	1,760	2,090	2,200	2,180	2,240	2,720	2,850	3,050	5,330	1,650	956	879	27,905
2004	1,430	1,730	2,150	2,270	2,160	2,650	2,430	2,010	1,840	2,420	1,620	1,250	23,960
2005	1,851	2,174	2,408	1,932	2,372	2,771	2,811	3,796	4,848	1,551	1,517	1,309	29,340
2006	1,906	2,140	2,809	2,658	2,229	2,519	2,571	2,104	1,591	1,016	1,101	1,440	24,084
2007	1,958	1,972	2,404	2,497	9,249	3,576	4,036	20,160	11,260	6,032	3,689	2,237	69,070
2008	2,384	2,487	3,047	2,941	2,888	3,247	3,358	24,260	10,080	3,971	2,606	2,273	63,542
2009	3,213	3,029	3,195	3,300	3,096	3,338	3,503	3,384	2,999	2,838	2,313	2,281	36,489
2010	3,110	3,340	3,235	3,588	3,326	6,157	3,661	3,451	6,849	3,707	3,570	2,446	46,440
Average	2,751	2,998	3,149	3,177	3,774	4,404	3,724	5,108	5,278	3,756	2,662	2,302	43,083
Average 1951-1999	2,861	3,123	3,251	3,282	3,889	4,617	3,848	4,805	5,432	4,026	2,797	2,448	44,379

Source:
1951-1999: USGS
1999-2012: Nebraska DNR Annual Hydrographic Report and Station List

Table - 1B

Estimated Baseflow - Medicine Creek above Harry Strunk Lake, Ne (6841000)
(values in ac-ft)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1951	3,058	3,219	3,349	3,115	2,775	3,241	3,375	3,813	3,826	3,889	3,760	3,451	40,872
1952	3,577	3,676	3,897	3,870	3,651	4,004	3,770	3,555	3,073	2,754	2,461	2,239	40,526
1953	2,515	2,978	3,453	3,637	3,348	3,652	3,407	3,309	2,809	2,281	1,916	1,777	35,081
1954	2,214	2,967	3,515	3,549	3,211	3,530	3,278	3,113	2,488	1,732	1,514	1,902	33,013
1955	2,442	2,848	3,299	3,508	3,238	3,517	3,218	2,999	2,330	1,522	1,316	1,782	32,018
1956	2,209	2,334	2,571	2,688	2,760	3,384	3,233	2,763	2,206	1,902	1,726	1,715	29,492
1957	1,989	2,306	2,690	2,911	2,847	3,429	3,499	3,692	3,297	2,721	2,408	2,423	34,209
1958	2,794	3,180	3,527	3,508	3,313	4,036	3,882	3,538	3,014	2,745	2,552	2,469	38,558
1959	2,813	3,237	3,517	3,314	3,046	3,730	3,637	3,410	2,749	2,026	1,862	2,319	35,662
1960	2,882	3,208	3,546	3,568	3,503	4,102	3,998	3,793	3,134	2,445	2,078	2,106	38,362
1961	2,477	2,891	3,159	2,977	2,836	3,699	3,776	3,690	3,036	2,209	1,855	2,057	34,662
1962	2,458	2,762	2,925	2,655	2,475	3,232	3,319	3,286	3,253	3,681	3,816	3,627	37,489
1963	3,735	3,656	3,709	3,522	3,181	3,734	3,543	3,264	2,636	2,026	1,955	2,472	37,434
1964	2,988	3,144	3,471	3,656	3,607	4,080	3,797	3,342	2,521	1,695	1,499	2,004	35,803
1965	2,567	2,889	3,187	3,165	2,881	3,266	3,152	3,149	2,734	2,263	2,287	2,841	34,381
1966	3,365	3,453	3,681	3,703	3,379	3,799	3,509	3,196	2,716	2,462	2,457	2,723	38,441
1967	3,123	3,275	3,522	3,531	3,242	3,706	3,624	3,692	3,371	3,102	2,881	2,746	39,815
1968	3,025	3,338	3,709	3,802	3,593	3,822	3,633	3,631	2,987	2,079	1,716	1,988	37,322
1969	2,471	2,873	3,314	3,505	3,333	3,881	3,615	3,213	2,782	2,740	2,759	2,849	37,336
1970	3,222	3,481	3,783	3,774	3,485	4,052	3,802	3,449	2,642	1,746	1,484	1,936	36,854
1971	2,529	2,971	3,452	3,673	3,482	4,003	3,835	3,711	3,049	2,250	1,992	2,350	37,296
1972	2,859	3,177	3,528	3,590	3,412	3,703	3,504	3,388	2,813	2,154	1,931	2,208	36,267
1973	2,564	2,686	3,113	3,586	3,482	3,907	3,691	3,559	3,167	2,953	2,887	2,993	38,588
1974	3,296	3,383	3,615	3,652	3,356	3,814	3,542	3,224	2,503	1,729	1,516	1,935	35,564
1975	2,411	2,660	2,962	3,048	2,891	3,438	3,267	2,977	2,437	1,996	1,793	1,875	31,756
1976	2,163	2,394	2,902	3,462	3,458	3,579	3,262	3,064	2,568	2,131	1,981	2,161	33,126
1977	2,432	2,494	2,698	2,796	2,746	3,461	3,483	3,408	2,849	2,179	1,910	2,110	32,565
1978	2,397	2,474	2,641	2,647	2,550	3,201	3,233	3,202	2,558	1,619	1,197	1,385	29,104
1979	1,804	2,245	2,538	2,446	2,365	3,102	3,135	2,978	2,639	2,487	2,317	2,156	30,211
1980	2,407	2,769	3,112	3,152	3,000	3,281	3,100	2,957	2,278	1,354	1,025	1,376	29,812
1981	1,885	2,339	2,706	2,746	2,598	3,117	3,032	2,893	2,615	2,567	2,419	2,190	31,107
1982	2,402	2,756	3,015	2,892	2,661	3,205	3,291	3,517	3,107	2,436	2,153	2,328	33,763
1983	2,704	2,953	3,298	3,443	3,205	3,616	3,458	3,407	2,806	2,014	1,658	1,819	34,381
1984	2,198	2,532	2,947	3,193	3,106	3,320	3,161	3,153	2,740	2,281	2,016	1,999	32,647
1985	2,286	2,596	2,921	2,998	2,787	3,190	3,058	2,979	2,580	2,208	2,093	2,273	31,968
1986	2,483	2,411	2,682	3,067	2,949	3,265	3,085	3,025	2,451	1,678	1,398	1,683	30,176
1987	2,107	2,423	2,819	3,052	2,871	3,191	2,910	2,608	2,076	1,613	1,434	1,584	28,689
1988	2,011	2,478	2,934	3,128	3,024	3,242	2,989	2,757	2,283	1,889	1,782	2,002	30,519
1989	2,359	2,568	2,865	2,991	2,768	3,083	2,806	2,494	1,994	1,596	1,557	1,908	28,990
1990	2,323	2,525	2,832	2,992	2,786	3,106	2,926	2,827	2,264	1,531	1,205	1,360	28,677
1991	1,801	2,323	2,775	2,920	2,725	3,066	2,949	2,952	2,439	1,718	1,411	1,588	28,670
1992	2,007	2,430	2,818	2,922	2,784	2,976	2,724	2,477	2,159	2,086	2,044	2,043	29,470
1993	2,270	2,441	2,772	3,024	2,965	3,562	3,497	3,401	3,232	3,444	3,503	3,399	37,509
1994	3,594	3,630	3,856	3,908	3,537	3,873	3,547	3,278	2,735	2,303	2,153	2,328	38,741
1995	2,686	2,900	3,209	3,323	3,075	3,454	3,314	3,308	2,737	1,949	1,669	1,973	33,598
1996	2,382	2,611	2,832	2,777	2,693	3,159	3,104	2,995	2,764	2,798	2,847	2,913	33,875
1997	3,119	3,069	3,078	2,832	2,643	3,409	3,424	3,258	2,816	2,485	2,462	2,776	35,371
1998	3,152	3,202	3,434	3,529	3,245	3,623	3,401	3,250	2,707	2,136	1,773	1,683	35,135
1999	2,001	2,487	2,990	3,261	3,064	3,373	3,157	3,050	2,516	1,887	1,662	1,902	31,351
Average	2,583	2,850	3,167	3,245	3,060	3,515	3,366	3,224	2,724	2,235	2,043	2,198	34,209

Source: Republican River Compact Administration Groundwater Model Appendix A, June 30, 2003

Table - 2

Total Streamflow - Medicine Creek below Harry Strunk Lake, Ne (6842500)
(values in ac-ft)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1951	208	191	293	959	959	2,446	2,983	14,150	26,123	15,672	5,371	13,994	83,348
1952	2,340	2,816	4,393	4,284	3,852	4,683	5,113	485	1,424	2,519	5,465	1,083	38,457
1953	1,531	1,152	2,926	4,147	4,118	4,106	3,495	3,590	3,360	4,173	7,791	4,352	44,741
1954	1,954	50	226	426	2,916	3,771	1,603	3,529	3,499	12,534	5,512	3,457	39,476
1955	450	353	373	363	335	1,535	333	2,594	9,949	11,841	12,843	3,752	44,722
1956	593	394	338	373	389	425	428	2,103	3,764	10,830	6,665	4,217	30,518
1957	1,703	448	228	314	267	321	273	17,202	10,086	8,591	4,693	3,650	47,775
1958	4,602	4,324	1,907	3,217	4,106	4,267	4,840	4,202	3,431	4,945	8,440	1,488	49,768
1959	1,640	1,595	1,980	2,981	4,019	3,568	5,320	6,625	3,291	10,969	7,746	1,040	50,772
1960	303	317	344	333	3,731	20,696	11,032	8,204	8,247	9,505	10,741	2,536	75,989
1961	323	169	229	233	235	1,458	1,901	4,126	4,510	10,645	7,273	1,817	32,921
1962	254	302	291	315	247	3,831	2,536	5,103	27,618	26,507	15,771	3,630	86,405
1963	3,140	3,150	3,616	3,850	5,911	4,508	2,805	2,588	13,805	16,903	5,948	30	66,254
1964	18	23	109	246	1,698	5,912	6,075	967	7,171	11,902	10,250	1,512	45,886
1965	387	342	275	249	231	1,395	3,767	6,161	6,293	5,447	7,420	690	32,655
1966	1,404	2,985	3,590	4,106	6,409	5,304	2,529	2,144	3,118	7,592	2,508	2,140	43,830
1967	2,773	4,862	3,525	3,882	3,852	3,777	3,213	3,386	16,312	14,460	7,797	764	68,601
1968	498	2,822	3,281	3,743	3,864	4,126	3,225	3,707	3,231	14,781	6,230	146	49,654
1969	251	164	239	1,194	1,081	4,193	5,576	4,199	15,531	13,197	12,632	280	58,536
1970	249	209	1,902	3,422	4,350	4,171	3,828	2,751	5,040	17,887	7,275	437	51,521
1971	110	39	203	201	182	218	712	5,405	4,140	11,145	10,909	682	33,946
1972	134	143	121	144	203	273	2,680	5,403	2,934	12,615	10,906	96	35,651
1973	96	85	82	103	105	2,641	4,400	3,541	6,683	13,580	11,853	733	43,902
1974	139	88	192	212	235	543	3,265	2,715	4,729	20,200	4,749	78	37,144
1975	133	71	102	111	89	47	41	653	7,972	13,845	9,352	1,271	33,686
1976	128	129	146	142	143	170	2,725	2,533	5,875	17,971	11,509	758	42,228
1977	25	42	40	44	50	57	69	1,279	4,992	12,117	7,192	52	25,959
1978	89	65	56	58	82	10,806	3,957	2,665	5,204	18,960	11,758	1,357	55,056
1979	80	76	61	78	133	106	48	54	1,653	2,571	9,331	2,611	16,801
1980	494	2,975	2,850	2,850	5,706	4,803	2,517	2,858	2,878	16,532	9,369	1,228	55,061
1981	31	48	47	44	37	45	63	56	700	5,652	6,975	613	14,311
1982	199	1,734	6,052	2,676	3,646	1,792	1,603	3,404	3,866	8,059	6,330	583	39,942
1983	63	52	1,450	3,295	3,479	2,561	2,682	4,562	3,318	5,568	10,344	3,419	40,792
1984	86	85	49	51	59	822	3,225	4,868	3,852	10,445	12,758	2,687	38,986
1985	76	65	65	61	65	1,297	2,606	3,523	2,979	6,792	9,711	2,431	29,671
1986	67	65	48	44	69	3,063	2,897	1,163	6,105	13,722	9,023	348	36,613
1987	29	25	27	28	29	35	48	2,036	3,955	8,698	9,592	413	24,916
1988	35	30	30	23	2,195	3,314	1,688	853	11,381	8,724	8,477	71	36,823
1989	17	22	29	28	28	1,305	1,336	1,218	3,499	13,238	9,959	1,749	32,426
1990	21	23	27	23	24	44	1,168	955	6,458	14,515	8,259	64	31,584
1991	17	18	20	21	13	30	30	55	4,917	12,633	10,052	1,454	29,260
1992	118	21	22	24	24	29	28	24	1,146	5,927	4,185	952	12,500
1993	42	28	1,740	2,559	4,592	10,842	1,953	1,713	4,191	16,392	10,695	4,391	59,137
1994	4,417	7,329	4,423	3,890	4,524	4,087	2,624	1,451	6,768	7,920	10,885	183	58,502
1995	18	16	29	34	35	2,590	1,220	2,100	3,940	12,420	13,810	2,290	38,502
1996	15	19	19	23	22	36	33	27	756	5,050	3,610	6,250	15,860
1997	3,510	3,020	3,660	3,630	3,290	2,700	982	1,020	4,970	15,290	10,250	1,110	53,432
1998	24	28	38	24	28	1,060	2,290	1,680	8,130	10,740	9,740	832	34,614
1999	1,360	45	56	49	46	33	25	34	1,990	13,250	5,350	340	22,578
2000	15	47	47	1,940	2,700	2,960	1,100	2,380	7,090	8,940	10,710	46	37,975
2001	119	44	35	40	37	1,320	3,060	1,660	5,000	10,200	9,920	17	31,452
2002	16	60	43	30	41	39	45	251	4,660	12,450	7,130	70	24,835
2003	55	8	15	9	6	58	69	29	347	11,400	7,910	69	19,976
2004	57	11	17	17	19	39	218	183	3,570	7,930	10,310	891	23,262
2005	59	20	23	26	22	37	41	34	1,326	10,320	7,976	90	19,974
2006	87	339	40	27	126	107	156	66	1,836	13,030	7,178	39	23,031
2007	39	44	32	33	38	1,966	2,460	3,180	21,480	12,160	4,395	27	45,854
2008	34	1,671	2,898	2,997	2,981	3,390	2,361	14,020	15,670	8,664	5,168	1,151	61,005
2009	1,828	3,828	3,096	3,078	2,711	3,219	2,157	2,162	3,901	6,250	8,993	873	42,096
2010	77	165	2,861	3,116	2,926	7,805	843	2,732	4,074	7,866	8,430	1,431	42,326
Average	643	821	1,014	1,174	1,555	2,680	2,172	3,039	6,246	11,245	8,557	1,579	40,725

Source:
1951-1994: USGS
1994-2012: Nebraska DNR Annual Hydrographic Report and Station List

Table 3

Example of Effect of Augmentation Credit for Nebraska Statewide Compliance and Kansas Allocation

Actual Accounting for 2002 - 2007

Table 3C: Nebraska's Five-Year Average Allocation and CBCU

Year	Allocation	Computed Beneficial Consumptive Use	Imported Water Supply Credit	N-CORPE AWS Credit	Allocation - (CBCU - IWS Credit)
2002	236,550	265,910	14,000		-15,360
2003	227,580	262,780	9,780		-25,420
2004	205,630	252,650	10,381		-36,639
2005	199,450	253,740	11,965		-42,325
2006	187,060	228,410	12,214		-29,136
2007	244,380	242,830	21,933		23,483
Averages					
2002 - 2006	211,250	252,700	11,670		-29,780
2003 - 2007	212,820	248,080	13,250		-22,010

Adjusted for N-CORPE

Table 3C: Nebraska's Five-Year Average Allocation and CBCU

Year	Allocation	Computed Beneficial Consumptive Use	Imported Water Supply Credit	N-CORPE AWS Credit	Allocation - (CBCU - IWS Credit)
2002	233,340	265,910	14,000	60,000	41,430
2003	224,370	262,780	9,780	60,000	31,370
2004	202,420	252,650	10,381	60,000	20,151
2005	196,240	253,740	11,965	60,000	14,465
2006	183,850	228,410	12,214	60,000	27,654
2007	244,380	242,830	21,933	0	23,483
Averages					
2002 - 2006	208,040	252,700	11,670	60,000	27,010
2003 - 2007	210,250	248,080	13,250	48,000	23,420

Assume 10% transit loss from augmentation discharge to the Medicine Creek accounting gage (Gage flow increases by 54,000 acre-feet) and no additional loss below Medicine Creek.

Changes Resulting from Proposed Accounting

Year	Change in compliance status	Change in Allocation	
		Nebraska	Kansas
2002	56,790	-3,210	-2,790
2003	56,790	-3,210	-2,790
2004	56,790	-3,210	-2,790
2005	56,790	-3,210	-2,790
2006	56,790	-3,210	-2,790
2007	0	0	0
Averages			
2002 - 2006	56,790		
2003 - 2007	45,430		

Table 4
Summary of Nebraska CBCU
2002 - 2006

Year	Total CBCU	GW CBCU	Surface Water CBCU					SW % ot Total
			Reservoir Evaporation	Project Canals	Private Canals	Pumps	Total SW	
2002	265,910	180,438	30,669	43,903	3,871	7,025	85,472	32%
2003	262,780	204,164	25,904	24,327	4,082	4,302	58,616	22%
2004	252,650	213,115	16,054	15,273	3,105	5,106	39,535	16%
2005	253,740	210,879	20,643	12,278	4,105	5,834	42,861	17%
2006	228,410	198,412	12,275	11,366	2,651	3,706	29,998	13%
Average	252,698	201,402	21,109	21,429	3,563	5,194	51,296	20%

Sources: Requirements for Nebraska's Compliance with the Republican River; Groundwater and Total Surfacewater from Table 1, SWE, Nov. 18, 2011

Note: 2006 reservoir evaporation excludes Harlan County Reservoir

FIGURES

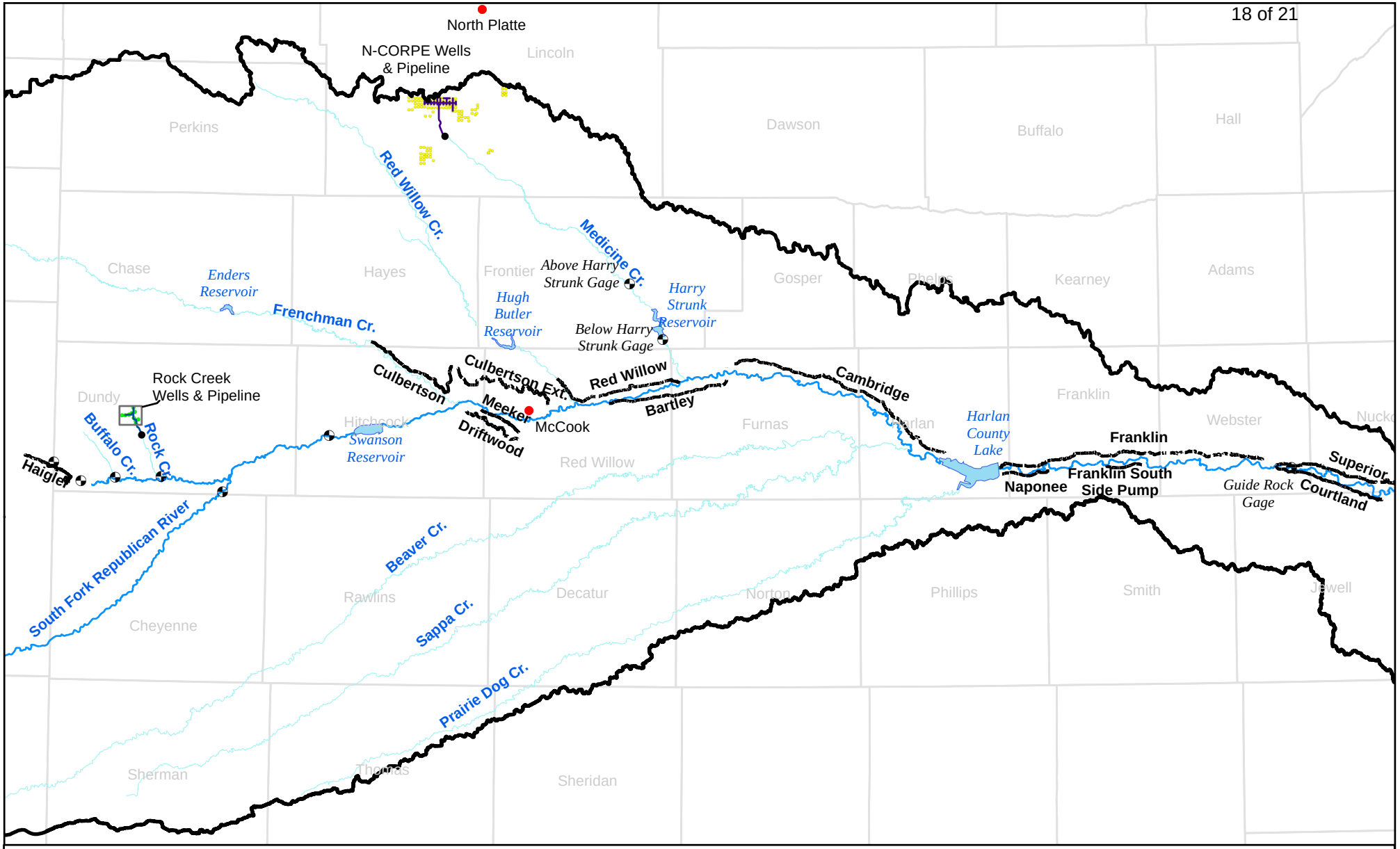


Figure 1

Republican River Basin - Nebraska

- Discharge Point
- Rock Creek Aug. Wells
- N-CORPE Aug. Wells
- Canals
- Streams
- Rivers
- Reservoirs
- County
- Republican River Basin

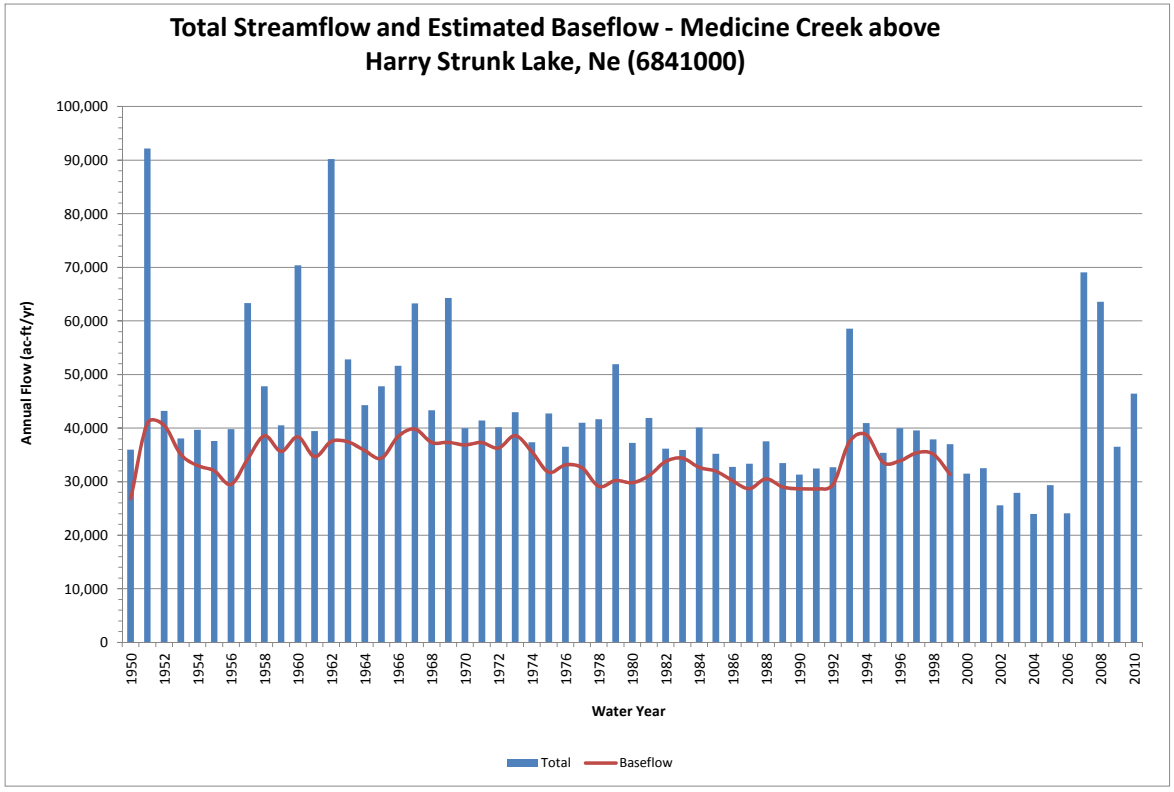
Miles
10 5 0 10 20

Approximate Scale = 1:1,350,000

Spronk Water Engineers, Inc.
1000 Logan Street Denver, CO 80203

January 24, 2014

Figure - 2


Total Streamflow and Estimated Baseflow - Medicine Creek above Harry Strunk Lake, Ne (6841000)
Annual Flow (ac-ft/yr)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Water Year
Total
Baseflow

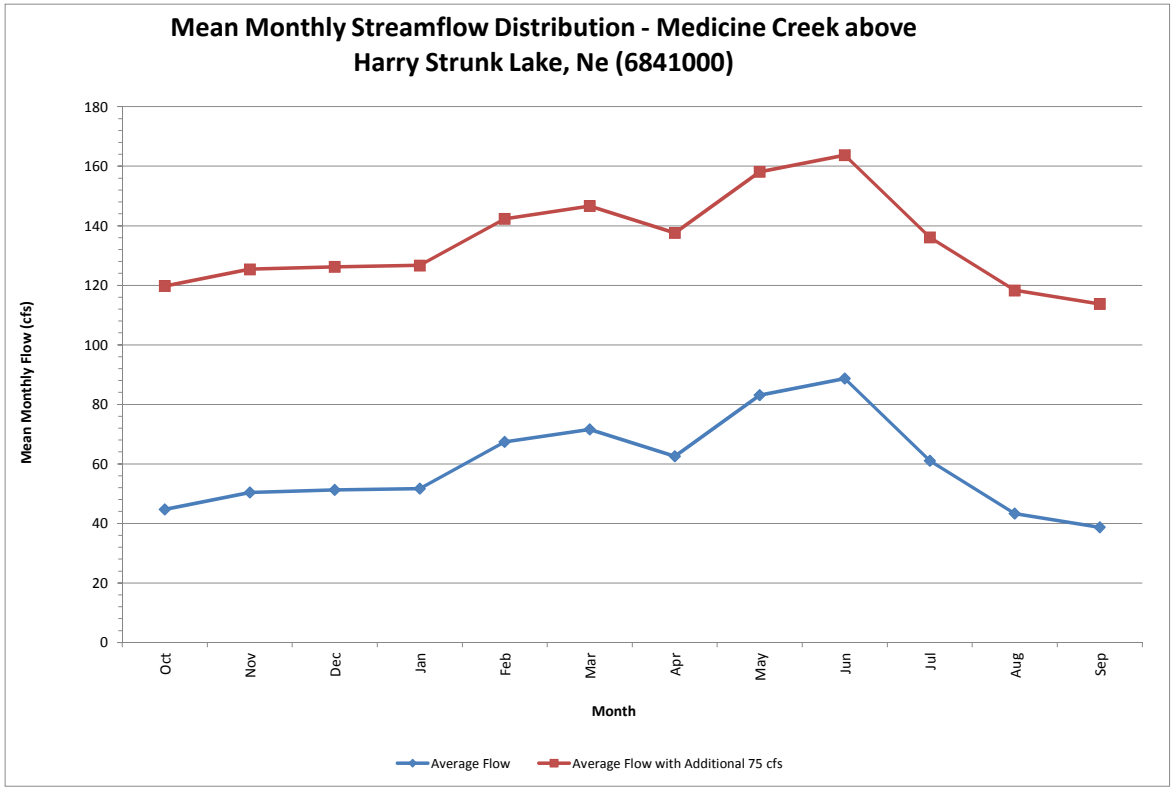

Mean Monthly Streamflow Distribution - Medicine Creek above Harry Strunk Lake, Ne (6841000)
Mean Monthly Flow (cfs)
180
160
140
120
100
80
60
40
20
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month
Average Flow
Average Flow with Additional 75 cfs

Figure - 3

Harry Strunk Reservoir
End of Month Contents
acre - feet

Month	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Monthly Mean
Jan	35000	28100	27,900	20,200	23,600	23,600	28,700	25,200	34,200	33,523	33,792	34,117	33,523	28,941
Feb	35600	31000	30,200	22,400	25,800	25,900	30,600	32,600	34,100	33,954	34,299	33,541	33,900	30,663
Mar	36300	34500	32,900	24,900	28,200	28,100	33,200	33,800	33,800	33,846	33,470	33,239	34,117	31,779
Apr	37600	35900	35,100	27,700	30,200	30,400	35,000	36,400	34,800	35,183	36,162	36,143	35,333	33,856
May	37700	37200	36,400	30,300	31,400	33,200	35,800	43,700	46,500	36,487	36,391	38,981	34,518	36,698
Jun	31700	33600	32,600	34,200	29,100	36,100	34,800	36,800	40,300	35,859	39,324	37,945	28,377	35,037
Jul	25200	24600	19,100	23,700	23,500	26,000	22,400	31,300	34,900	32,471	35,090	33,081	19,737	27,389
Aug	16600	17100	12,400	16,300	14,700	20,300	16,600	30,100	32,400	26,137	30,743	24,885	13,042	21,601
Sep	17600	18800	12,800	16,900	15,100	21,000	17,700	31,600	32,700	27,200	30,972	25,279	13,907	22,287
Oct	20000	20800	14,400	17,900	17,000	22,700	19,400	33,500	34,100	30,662	33,010	27,704	15,523	24,173
Nov	23100	23100	16,300	19,600	19,100	24,500	21,200	34,000	33,300	33,684	33,738	30,163	17,629	25,747
Dec	25300	25400	18,200	21,500	21,200	26,800	23,800	34,200	33,200	33,630	33,936	33,098	19,939	27,228

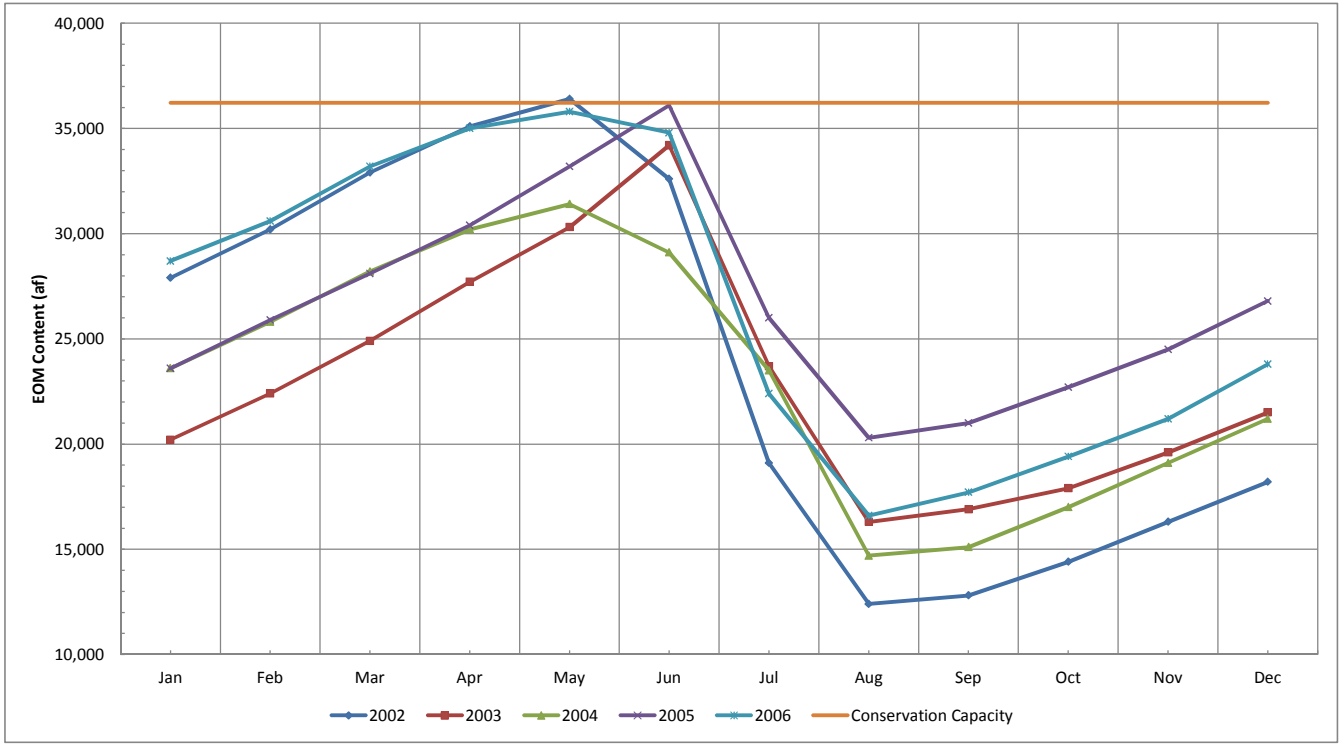


Figure - 4

Harlan County Reservoir
End of Month Contents
acre - feet

Month	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Monthly Mean
Jan	302200	221200	248,100	160,100	113,700	107,600	130,100	118,900	261,200	318,499	324,993	327,970	326,482	227,773
Feb	318000	233800	255,300	161,400	114,100	112,600	131,400	141,000	269,700	319,581	340,757	329,729	335,503	235,605
Mar	331600	264800	263,700	164,200	115,800	118,800	136,000	157,600	279,400	321,070	336,194	327,835	322,423	241,494
Apr	331200	285400	269,600	169,800	116,400	128,700	138,400	186,000	291,100	329,999	337,577	325,399	323,640	248,709
May	333000	306000	276,200	175,600	116,700	131,800	137,700	207,300	351,400	333,290	334,812	335,365	318,634	258,292
Jun	297600	304200	258,600	178,600	114,100	141,100	132,000	242,100	341,300	328,917	368,695	336,194	290,189	256,430
Jul	262300	275800	195,900	142,200	114,700	137,700	120,700	249,800	319,400	312,259	329,458	314,907	241,599	232,056
Aug	211300	239300	166,400	121,300	111,500	137,000	118,300	248,600	314,500	290,943	310,670	305,904	202,945	213,743
Sep	204800	236500	161,300	117,700	108,900	131,800	116,100	246,900	312,800	286,167	304,061	302,388	197,485	209,762
Oct	205400	235900	162,500	115,600	108,100	129,700	115,100	248,100	334,700	292,473	303,417	319,581	193,382	212,612
Nov	209900	238600	161,700	114,300	107,900	128,100	114,400	249,300	319,200	306,434	309,478	322,693	191,125	213,318
Dec	215000	242900	160,500	113,300	107,100	128,100	116,300	255,400	319,300	320,258	318,364	322,964	191,125	216,201