Non-Binding Arbitration initiated March 21, 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 Rock Creek Augmentation Plan

Republican River Compact

Response to report prepared by State of Nebraska, dated February 8, 2013

Prepared by

Dale E. Book

Spronk Water Engineers, Inc.

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1.0 Introduction

The State of Nebraska submitted a proposal to the RRCA on February 8th, 2013 for approval of the Rock Creek Augmentation Project as an Augmentation Plan, as referenced in subsection III.B.1.k of the Final Settlement Stipulation (FSS). The FSS requires RRCA approval of Augmentation Plans prior to implementation.

The Rock Creek Augmentation Project is described in the report attached to the submittal prepared by Nebraska DNR. The Project involves retirement of acreage and consolidating pumping associated with the acreage into a well field, currently consisting of 10 augmentation wells. The Project is located within and managed by the Upper Republican Natural Resources District (URNRD). The physical location is in Dundy County, approximately 12 miles northeast of Haigler, NE. The augmentation project consists of the wells to be pumped and a pipeline system to collect the discharge for delivery to Rock Creek. Rock Creek is a compact subbasin, with separate allocation and consumptive use accounting. A stream gage located at the mouth of Rock Creek at Parks, NE is used for compact accounting. The augmentation discharge to Rock Creek is approximately 11 miles upstream of the gage. The location of the Project is shown on Figure 1.

The Plan submitted by Nebraska consists of modifications to the RRCA Accounting Procedures. The modifications are generally to identify the amount of augmentation pumping as a deduction to the Rock Creek gage in calculating the Virgin Water Supply (VWS) of the Rock Creek Basin and to include the value as a credit in the compliance accounting. These accounting calculations are done on an annual basis.

The Project is expected to be operated for the purpose of compact compliance, during years when Nebraska anticipates the need for actions under the current IMPs (Compact Call Years). The Project operations began in late February, 2013. The combined discharge rate has been approximately 28 cfs.

The FSS provides that augmentation wells approved pursuant to RRCA action not cause any new net depletion. The Nebraska proposal provides for a separate category of augmentation pumping as part of the Plan, designated to replace new net depletions associated with the augmentation wells. It has been proposed that this pumping occur every year and is identified as "Maintenance" pumping. Nebraska estimated the amount of maintenance pumping to be 300 acre-feet/yr., with the condition that the actual amount be calculated during the life of the project. The average historical pumping would be used to simulate the difference in stream depletion resulting from actual pumping. (pg. 5, DNR report, 2013) Annual maintenance pumping would not be less than 300 acre-feet. (pg. 6, *ibid.*)

2.0 Summary of Opinions

1. The quantities to be pumped pursuant to the Rock Creek Augmentation Plan should be limited to the historical net pumping to effectively conform to the provision in the FSS preventing any new net depletion from these wells.

    a. The provision is intended to prevent enlarged use of the wells.

    b. Enlarged use causes an increase of stream depletions, including delayed (post-pumping) depletions.

    c. The allocation of part of the augmentation well discharge to offset enlarged depletions from pumping is not equivalent to limiting well development.

    d. Application of historical use limits on changed uses is a conventional means of preventing enlarged use.

2. The stream losses incurred to the augmentation discharge must be accounted for in crediting.

    a. Without accounting for losses, the augmentation credit is overstated. Losses to bank storage, the aquifer and ET would be inappropriately credited as accretions to streamflow.

    b. The RRCA GW Model can be used to quantify the losses and credit.

    c. The FSS requires computing augmentation credit with the Model.

3. Terms and conditions are necessary for the Augmentation Plan to operate within the requirements of FSS. The necessary elements should include at least the following specific provisions;

    - Substantive standards for operational limits,

    - Data collection and specifications for reporting and verification,

    - Methodology to quantify the augmentation credit.

3.0 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 18 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 two previous arbitration proceedings and at the trial in Kansas v. Nebraska & Colorado currently pending.

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 surface water rights. This process requires investigations to determine historical consumptive use and impacts to streamflow caused by well pumping and return flows. New water uses are conditioned on protecting streamflows from depletions by balancing historical consumptive use and return flows with pumping depletions.

4.0 Project Description and Hydrologic Data

The Rock Creek Augmentation Project will produce augmentation supply by pumping groundwater from the regional aquifer into the stream, in this case in the headwaters of Rock Creek. The augmentation supply to streamflow results because some significant portion of the pumping is derived from aquifer storage, with stream depletions during the time of pumping being a fraction of the amount pumped and discharged. Augmentation well pumping provides temporary supply and causes depletions to the connected stream system that continue beyond the time when pumping stops (post-pumping depletion).

The historical use of the wells identified with the Rock Creek Project was documented by pumping records maintained by the URNRD and submitted by Nebraska to the RRCA with this proposal. The certified acreage for the wells was 3,262 acres. The pumping records for the 24 wells are summarized in Table 1 for the years 1985 – 2010, as reported by the URNRD. Our review of the data indicates that flow meter data became available in approximately 1998. Pumping over the period of 1998 to 2010 averaged 3,925 acre-feet/yr, or 14.4 inches on the certified acreage. The annual pumping depths ranged from 10 to 20 inches. The long term average was 4,154 acre-feet/yr, or 15.3 inches. For the period from 2001 – 2010 the average was 3,700 acre-feet/yr or 13.6 inches. The pumping data are plotted on Figures 2 and 3.

The URNRD has reported that an additional 1,900 acres was purchased near the project site, also to be retired from irrigation. This would reportedly provide the offset needed to operate the project at the full capacity for 2013. This acreage and historical use was not reported to the RRCA in the Nebraska submittal of February.

The historical consumptive use associated with the wells is expressed as the pumping minus return flow, or net pumping. This is the form of input into the RRCA GW model in general, where both pumping and aquifer recharge are specified. The amount of recharge from pumping used in the current RRCA accounting is expressed as percentages of pumping. The methodologies and percentages used by each of the three states to compute recharge rates are different. The rates considered applicable by Colorado and Kansas for center pivot sprinklers currently range from 12% to 17%.

The flows on Rock Creek are measured at the USGS gaging station near the mouth of the stream. In recent years, flows have been approximately 5 to 7 cfs at the gage. Table 2 is a monthly

summary of the streamflow measured at the gage, in acre-feet. The daily flow rates are plotted on Figure 4 for the period of 2001 to the present. Downstream of Rock Creek the Republican River flows into Swanson Reservoir. The dam is located approximately 38 miles downstream of Rock Creek. A USGS gaging station on the river is located at Stratton, just upstream of Swanson Reservoir. The data at this site are summarized in Table 3. The daily flows for the period of 2001 to the present are plotted on Figure 5. There are periods of no flow at Stratton from mid-summer to the fall. This is the prevailing condition at the Stratton gage, as can be seen on Figure 5. The duration of no flow periods has increased since 2000.

5.0 Limitation on Augmentation Pumping

The FSS provides that "such wells shall not cause any new net depletion to stream flow, either annually or long term." (FSS, III.B.1.k) This limitation indicated the understanding that wells used for augmentation supply would be acquired or constructed to replace existing wells. For this limitation to be effective, a baseline of historical use of the wells being converted to augmentation pumping is necessary. The interpretation applied to this provision by Nebraska results in expanded pumping amounts and stream depletions. If it is found acceptable to allocate a fraction of the pumping to offset increased depletions due to pumping, there would be no limitation imposed by the FSS on the augmentation pumping.

Any augmentation pumping plan intended for long term replacement of stream depletions and deriving its supply from a tributary aquifer is eventually unsustainable as a source of supply because either the depletion rate reaches the pumping rate, or the source is depleted. As a result, stream depletion extends beyond the pumping period. To the extent the pumping was increased, the depletions are also larger. Limiting pumping to the historical levels prevents this enlargement of depletion.

There are several reasons why the use of the wells should not be enlarged beyond the historical levels of use for the Rock Creek Augmentation Project to be within the limitations expressed in the FSS.

1. There is a limitation in the FSS, in conjunction with the well moratorium put in place by the settlement agreement. This provision of the FSS was described in more detail in the 2nd Report of the Special Master, noting that the States agreed they could acquire existing wells and retire the consumptive use and use the wells, or new wells, for compact compliance (pg. 44, footnote 92).

   If the use of the wells could be enlarged by replacing additional depletions with a fraction of the water pumped, the only practical volume limit on any augmentation pumping plan would be the physical capacity of the system. As proposed, the Rock Creek Augmentation Plan would therefore not be subject to any limitation derived from the moratorium or FSS. The

historical use of the wells is a reasonable and commonly used limitation adopted to prevent expanded use when a change of use is made. This project involves a change in use of the wells that were used on the property acquired by the URNRD and are to be retired from use.

2. The FSS provides that the wells are being used for the sole purpose of compact compliance. This would not include the periodic use of the wells to offset their own increased depletions separate and apart from the use for compact compliance, as requested in the Nebraska proposal.

3. A limitation on the use of augmentation wells in general as a new source of water supply is the continuation of post-pumping depletions. The rate of stream depletion while the well is being pumped is a fraction of the pumping, but continues after pumping is stopped. This requires another source of water to offset the enlarged depletions that would continue beyond pumping. At such times, the wells are not available to augment their own depletions and the resulting depletions would in part be new net depletions.

4. This Project is located upstream of Swanson Reservoir. The moratorium in this area is subject to further restriction specified in III.A.3 of the FSS. (See pg. 42 of the 2nd Report) This provision specifies that the States will not increase the level of development of wells in the basins located upstream of Trenton Dam.

The Plan submittal included an illustrative example of possible pumping over a period of years averaging 5,400 acre-feet/yr, which exceeds the historical consumptive use. The proposal from Nebraska projects a supply that is not based on or limited to historical levels of use by the wells on the acreage being retired. The Project is currently being operated at its full capacity. The 2nd report of the Special Mater notes that the URNRD had implemented a moratorium at the time. Information concerning the Project reported by the URNRD notes that the land acquired by the District and previously irrigated is being retired from irrigation to provide the basis for the Project supply (URNRD, May, 2013).

The level of pumping indicated by the illustrative example in the Nebraska submittal is closer to the historical use amount if an additional 1,900 acres are added to the baseline. However, Nebraska has not committed to include the retirement of additional acreage as a basis for this Plan being considered by the RRCA.

The appropriate historical period of record to be used to establish the yield of the plan has not been established by the RRCA in any previous augmentation plan. One alternative would be for a period of time prior to the effective date of the moratorium in 2002. Another alternative that was previously deemed acceptable to the RRCA engineering committee was proposed by Colorado as the most recent ten-year period for their Colorado Compact Compliance Pipeline

augmentation plan. This plan was the subject of the arbitration proceedings in 2010. The historical pumping over the 10-year period 1993 – 2002 averaged 4,223 acre-feet/yr, or 15.5 inches. Assuming a range of recharge rates of 12% to 17%, this results in a range of average annual net pumping of 3,505 to 3,716 acre-feet/yr. The Nebraska illustrative pumping example of 5,400 acre-feet/yr exceeded the average annual net pumping by approximately 50%. It would be reasonable to express the net pumping as an average limit going forward, over a comparable period, such as 10 years. If a later period of use were to be adopted for the Rock Creek Plan, the average would be reduced. The figures presented here are based on the record for the wells that irrigated 3,261 acres.

In summary, the Plan proposed by Nebraska for augmentation pumping in excess of historical levels of use would result in enlarged depletions to be offset with a fraction of the augmentation supply during the time of pumping. This condition does not result in a limit on the amount to be pumped under the Plan and would effectively increase the level of well development. The use of the wells to facilitate enlarged depletions by offsetting them appears to be contrary to the FSS provision preventing increased level of well development in the areas covered by the moratorium.

6.0 Augmentation Credit

The Nebraska proposal requests a credit in the RRCA accounting equal to the full amount of the augmentation discharge, without adjustment for any loss of pumped water below the discharge point as this water flows downstream. This is inconsistent with how the well depletions are computed and will overstate the effect of the augmentation pumping on the water supply in the basin. The credit for augmentation supply is intended to offset depletions to streamflow in the accounting and should reflect the actual accrual to streamflow.

The pipeline discharges to Rock Creek reportedly at the location on the stream where live flow now begins. The distance is 11 miles upstream of the Rock Creek confluence with the Republican River. Losses, consisting of seepage to the channel or aquifer are likely to occur. Some of this loss will be consumed by evaporation and evapotranspiration.

Nebraska DNR has taken several field measurements of flow in Rock Creek since the start of pumping in February of this year. The data were provided to us on June 26th and consist of four sets of flow readings. The results are listed on Table 4 and are shown graphically on Figure 6. The measurements generally include spot discharge measurements between the pipeline outfall and the gage at Parks. The pumping or pipeline discharge rates were not available as part of the dataset. This information provides some indication of the change in flow in the 11 mile reach of stream covered since the pipeline began discharging. Some loss is evident in the data, assuming the gain prior to pumping was approximately 7 cfs. This is indicated by comparing the net

change in streamflow in this reach after the pipeline began discharging with the gain prior to the pumping.

The augmentation supply will provide an accounting credit for the Rock Creek subbasin and must also be deducted from the stream gage to determine the VWS for the subbasin. Additional loss will occur downstream in the Republican River. As noted in the discussion of streamflow data, there are consistently periods of no flow on the Republican River at Stratton, indicating periods of losing flow when augmentation discharge is likely to incur significant loss.

The RRCA GW model provides a technically viable means to determine the amount of flow expected to reach the confluence with the river and further downstream to Swanson Reservoir. The FSS provides that the credit for augmentation be determined with the RRCA model (FSS, IV.H.). This computation methodology would compare the baseflow with and without the augmentation discharge to determine the effect of the discharge on streamflow and compute the resulting augmentation credit.

If the loss of pumped augmentation water is not accounted for in determining the augmentation credit, the process would not be consistent with the way the stream-aquifer interaction is represented in the calculation of pumping depletion. The RRCA accounting counts consumptive use of pumping only to the extent that streamflow is depleted. Depletions of aquifer storage by pumping, a significant effect in this basin, are not counted. Without removing the seepage from the credit in the case of the augmentation discharge, the accretions to aquifer storage attributed to that flow would be inappropriately counted as credit in the compact accounting.

7.0 Terms and Conditions

The Plan notice, or request for RRCA action, contained revisions to the accounting procedures and a report describing general parameters of the Rock Creek Project. The Plan provides that maintenance pumping will be made each year to offset enlarged depletions to achieve compliance with the FSS.

The RRCA action on the Rock Creek Augmentation Plan should provide for adequate details for operations, accounting and reporting to ensure that the Plan is operated in accordance with the FSS requirements. This includes measurement and reporting of pumping and discharge, annual calculation of the amount of pumping that will occur and implementation of the no new net depletion limitation.

The specific operational details should include at least:

1. The limitation on the amount of augmentation pumping to correspond to an appropriate measure of historical development of the wells. The specifics would include over what period of time going forward this limit would apply and the average annual quantity.

2. The specific modeling method to determine the augmentation credit with the RRCA GW model each year.

3. The specific measurements of pumping and discharge to be collected, and provided to the RRCA each year.

4. Specific provision for notice of the pumping projection each year, including calculations and schedule.

These provisions should be integrated into the proposal being acted on by the RRCA.

8.0 References

1. Nebraska Department of Natural Resources, Nebraska Rock Creek Augmentation Project; Submittal to RRCA, February 8, 2013

2. Larson, Steven P. and Perkins, Samuel P., July 1, 2013, Report on the Nebraska Augmentation Plan, Expert Report prepared for Kansas in non-binding Arbitration initiated March 21, 2013 pursuant to Decree of May 19,2003, 538 U.S. 720 in Kansas v. Nebraska & Colorado No. 126, Orig., U.S. Supreme Court

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

4. McKusick, Vincent L., April 15, 2003, Second Report of the Special Master (Subject: Final Settlement Stipulation), Kansas v. Nebraska & Colorado No. 126, Orig., U.S. Supreme Court

5. Arbitrator's Final Decision, October 7, 2010, In non-binding Arbitration pursuant to the Final Settlement Stipulation, Kansas v. Nebraska & Colorado No. 126, Orig., U.S. Supreme Court, Colorado Compact Compliance Pipeline dispute

6. Nebraska Department of Natural Resources, Rock Creek Augmentation Measurement Notes, received via email from Nebraska Attorney General's office (Justin Lavene) on June 26, 2013

7. Upper Republican Natural Resource District's well database, URNRD_KS_RESPONSE.accdb, September 29, 2011

8. Upper Republican Natural Resource District's Newsletter (Report), May, 2013, http://www.urnrd.org/

9. United States Geological Survey Real-Time Water Data for the Nation (http://waterdata.usgs.gov/nwis/rt)

TABLES

Table 1

Nebraska's Rock Creek Augmentation Project

Historical Well Usage by Retired Irrigation Well

1985 - 2010

(acre-feet)

Well ID	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
49222	231	155	208	268	194	278	129	119	116	223	139	174	167	263	113
49223	152	183	191	208	179	219	124	149	126	106	158	94	117	118	112
49224	236	225	169	294	213	209	177	120	99	73	129	113	119	119	178
49225	278	213	214	262	221	275	145	112	154	107	192	252	339	349	228
49226	274	242	233	277	239	275	172	82	138	160	83	179	225	213	154
49227	268	236	244	305	213	267	140	85	147	152	93	155	112	223	149
49228	236	214	174	293	211	241	163	74	113	167	87	128	238	239	156
49229	242	207	176	283	215	264	195	73	118	178	73	122	219	221	165
49244	322	260	289	412	309	338	161	117	143	135	183	165	255	200	199
49245	256	231	231	276	256	300	193	81	129	200	192	139	117	169	169
49246	191	200	163	170	209	263	195	139	107	224	202	184	147	228	104
49367	278	259	229	318	230	329	152	137	125	111	174	143	212	177	171
49368	242	209	209	290	191	273	193	160	111	217	183	168	138	219	97
49369	419	359	289	429	265	418	318	281	175	389	359	241	444	496	236
49370	215	187	188	202	211	276	152	102	152	224	145	149	217	239	114
49472	236	227	223	306	194	279	142	116	129	97	138	134	195	148	142
51544	215	200	199	242	213	188	172	101	80	186	181	165	155	222	89
51545	239	228	223	266	227	194	207	121	68	172	206	180	152	226	102
51546	237	206	0	52	334	279	33	0	120	198	189	140	242	225	145
51722	233	133	233	309	177	195	140	103	14	157	148	183	244	141	164
51723	157	74	27	150	195	264	156	129	114	178	99	51	148	207	144
51724	172	77	154	289	206	276	203	150	109	162	179	122	222	213	143
52006	233	137	122	292	173	217	149	107	16	219	107	168	250	215	134
Total	5,561	4,664	4,390	6,192	5,073	6,117	3,811	2,659	2,601	4,035	3,641	3,548	4,673	5,070	3,408
5-yr Avg					5,176	5,287	5,117	4,771	4,052	3,845	3,350	3,297	3,700	4,193	4,068
10-yr Avg										4,510	4,318	4,207	4,235	4,123	3,956

Source: Nebraska Upper NRD database (URNRD_KS_RESPONSE.accdb), provided in response to the Kansas discovery request during the Kansas v. Nebraska & Colorado trial (2012).

Notes:

(1) Usage data reported in inches and converted to acre-feet.

(2) Well 49225 consists of two wells under one id number.

Table 1 (cont.)

Nebraska's Rock Creek Augmentation Project

Historical Well Usage by Retired Irrigation Well

1985 - 2010

(acre-feet)

Well ID	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average	Max	Min
49222	263	242	267	213	156	215	204	129	210	167	199	194	278	113
49223	183	223	280	163	244	115	185	157	80	88	68	155	280	68
49224	259	231	280	152	248	110	56	14	63	47	223	160	294	14
49225	355	302	351	376	288	32	130	137	195	146	114	222	376	32
49226	194	90	271	202	211	156	83	104	100	55	58	172	277	55
49227	212	103	33	143	213	144	183	164	135	39	150	166	305	33
49228	201	88	253	203	224	175	85	123	104	80	65	167	293	65
49229	210	94	110	141	189	139	184	186	182	143	188	174	283	73
49244	295	283	312	183	301	257	261	224	238	199	223	241	412	117
49245	182	176	81	154	150	113	71	95	103	71	75	162	300	71
49246	225	224	179	210	223	193	163	57	222	191	235	186	263	57
49367	160	170	206	210	222	97	230	212	217	192	218	199	329	97
49368	218	202	163	42	75	183	124	49	186	158	188	173	290	42
49369	512	431	487	396	334	18	144	115	148	105	85	304	512	18
49370	267	227	267	210	160	189	181	190	201	157	186	193	276	102
49472	230	218	255	131	252	114	221	178	207	172	215	188	306	97
51544	215	210	169	39	8	109	96	44	66	149	172	149	242	8
51545	227	218	180	45	48	155	143	50	211	166	215	172	266	45
51546	223	160	125	43	76	184	177	73	75	172	213	151	334	0
51722	263	225	275	207	259	128	157	140	150	190	185	183	309	14
51723	226	159	122	29	38	8	92	35	32	51	22	112	264	8
51724	184	82	256	191	207	151	65	88	80	0	0	153	289	0
52006	211	201	248	143	236	184	197	173	188	161	192	180	292	16
Total	5,517	4,562	5,171	3,827	4,360	3,168	3,431	2,736	3,394	2,900	3,486	4,154	6,192	2,601
5-yr Avg	4,443	4,646	4,746	4,497	4,687	4,218	3,991	3,505	3,418	3,126	3,189			
10-yr Avg	3,896	3,971	4,223	4,345	4,378	4,330	4,319	4,125	3,957	3,907	3,703			

Source: Nebraska Upper NRD database (URNRD_KS_RESPONSE.accdb), provided in response to the Kansas discovery request during the Kansas v. Nebraska & Colorado trial (2012).

Notes:

(1) Usage data reported in inches and converted to acre-feet.

(2) Well 49225 consists of two wells under one id number.

Table 2

Rock Creek Gage Flow

1985 - May, 2013

Monthly acre-feet

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	5-yr Running Avg	10-yr Running Avg
1985	641	620	476	679	831	588	627	627	689	783	837	776	8,174		
1986	752	649	714	678	700	627	628	575	674	724	630	748	8,099		
1987	730	629	871	631	846	640	627	567	615	599	686	701	8,143		
1988	780	642	714	695	943	688	615	578	615	625	662	678	8,237		
1989	724	653	622	646	617	699	576	640	599	614	637	637	7,663	8,063	
1990	706	623	750	669	789	601	558	590	509	534	582	634	7,544	7,937	
1991	726	570	730	660	764	1,098	607	588	533	585	714	664	8,239	7,965	
1992	686	649	724	661	566	620	650	706	568	465	540	710	7,543	7,845	
1993	690	600	764	737	978	678	598	639	590	650	640	676	8,240	7,846	
1994	676	655	658	634	511	525	549	488	660	601	624	633	7,214	7,756	7,910
1995	659	538	655	694	808	654	618	493	495	568	578	567	7,326	7,713	7,825
1996	515	518	600	536	677	532	634	613	581	551	523	531	6,812	7,427	7,696
1997	721	640	571	566	511	494	471	488	459	518	567	602	6,608	7,240	7,543
1998	624	610	496	477	475	509	560	528	481	538	550	488	6,336	6,859	7,353
1999	507	426	461	495	706	542	363	824	527	556	389	495	6,290	6,674	7,215
2000	581	527	569	514	363	380	378	380	362	536	529	488	5,609	6,331	7,022
2001	527	537	667	474	481	355	318	317	400	402	647	527	5,653	6,099	6,763
2002	562	687	608	539	462	468	452	467	349	524	627	569	6,314	6,040	6,640
2003	526	342	518	524	505	548	342	311	272	188	188	448	4,710	5,715	6,287
2004	474	421	453	514	381	420	486	362	436	444	493	610	5,494	5,556	6,115
2005	602	439	553	466	461	444	328	383	345	474	440	488	5,423	5,519	5,925
2006	513	462	457	411	395	324	330	344	433	516	539	406	5,129	5,414	5,757
2007	410	382	462	376	331	522	368	452	348	397	349	366	4,765	5,104	5,572
2008	373	417	455	485	365	393	366	409	382	393	409	405	4,852	5,133	5,424
2009	366	371	442	480	393	397	323	380	391	476	506	393	4,916	5,017	5,286
2010	472	451	478	601	447	401	347	403	402	467	336	448	5,253	4,983	5,251
2011	283	296	373	487	388	386	330	294	329	403	387	391	4,345	4,826	5,120
2012	399	380	393	417	402	311	253	253	265	352	370	377	4,173	4,708	4,906
2013	467	607	1,763	1,813	2,007										
Average	576	529	621	605	624	530	475	489	475	517	535	552	6,397		
Max	780	687	1,763	1,813	2,007	1,098	650	824	689	783	837	776	8,240		
Min	283	296	373	376	331	311	253	253	265	188	188	366	4,173		

Source: USGS 06824000 Rock Creek at Parks, Nebr.

Table 3

Republican River at Stratton, Nebraska Gage Flow

1985 - May, 2013

Monthly acre-feet

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	5-yr Running Avg	10-yr Running Avg
1985	6,544	10,221	8,543	7,793	8,763	1,611	2	1,328	2,520	4,280	5,913	5,929	63,447		
1986	8,835	7,470	7,583	7,359	2,618	2,728	1,043	2,351	79	2,581	4,641	5,034	52,322		
1987	5,516	6,500	7,480	8,579	12,956	4,475	1,321	0	0	1,316	3,560	5,100	56,802		
1988	5,030	6,177	6,637	8,973	10,564	3,801	475	83	266	862	2,999	4,439	50,306		
1989	5,869	5,665	6,357	4,869	2,445	5,453	3,231	1,037	1,043	1,864	3,880	5,052	46,766	53,928	
1990	6,446	6,843	7,543	6,680	7,452	3,430	0	0	0	204	2,089	3,596	44,284	50,096	
1991	3,556	7,857	6,383	6,603	6,672	7,694	3,566	2,501	226	1,611	5,718	7,180	59,569	51,545	
1992	8,208	9,951	10,626	6,996	2,329	4,994	1,921	7,648	3,509	2,934	5,004	6,214	70,334	54,252	
1993	5,794	6,302	13,339	8,700	8,362	4,723	3,346	3,314	2,781	3,989	5,945	6,724	73,318	58,854	
1994	6,317	8,654	8,959	8,257	4,419	1,574	261	7	56	2,344	3,995	3,971	48,816	59,264	56,596
1995	2,676	2,864	7,674	10,542	13,252	11,768	8,208	559	0	1,040	3,622	3,616	65,820	63,571	56,834
1996	2,942	4,382	6,875	5,500	5,472	5,433	1,939	2,479	7,783	3,642	5,520	6,167	58,134	63,284	57,415
1997	7,212	8,680	7,442	5,808	2,894	2,798	33	222	0	998	3,445	4,770	44,301	58,078	56,165
1998	5,050	5,205	5,145	4,510	5,732	880	15	558	0	502	4,015	3,066	34,679	50,350	54,602
1999	4,280	4,348	4,798	4,673	3,350	4,334	557	1,051	619	1,985	2,035	2,235	34,267	47,440	53,352
2000	2,384	4,671	6,992	4,814	1,397	0	13	0	0	242	1,440	1,549	23,502	38,977	51,274
2001	3,701	4,086	4,447	4,602	2,307	742	182	0	0	0	574	617	21,258	31,601	47,443
2002	2,112	2,805	4,011	3,277	709	55	0	1,904	0	0	0	1,390	16,262	25,994	42,036
2003	2,289	1,238	3,781	3,295	2,341	608	0	0	0	0	0	0	13,550	21,768	36,059
2004	1,191	1,978	2,696	2,186	739	0	13	0	0	0	0	0	8,802	16,675	32,058
2005	706	2,501	2,583	2,467	1,455	1,964	198	0	0	0	66	1,519	13,460	14,666	26,821
2006	2,725	2,116	2,993	2,208	315	0	47	0	0	0	0	2,133	12,537	12,922	22,262
2007	1,216	2,658	5,286	5,256	1,771	1,558	17	0	0	0	55	954	18,772	13,424	19,709
2008	865	1,725	3,715	3,570	2,341	1,041	7	0	0	247	1,851	2,382	17,743	14,263	18,015
2009	2,985	4,094	3,669	4,639	4,981	4,790	1,294	103	97	1,950	4,221	2,225	35,049	19,512	18,093
2010	3,162	4,280	7,523	6,764	4,983	2,698	906	2,252	91	39	1,438	2,977	37,112	24,243	19,454
2011	2,525	2,769	4,411	4,735	5,032	3,539	2,160	28	0	3	1,842	3,481	30,524	27,840	20,381
2012	3,963	4,241	3,927	4,181	1,800	92	0	0	0	0	0	0	18,204	27,726	20,575
2013	67	2,031	3,794	4,622	3,429										
Average	3,937	4,907	6,042	5,602	4,513	2,956	1,098	979	681	1,166	2,638	3,297	38,212		
Max	8,835	10,221	13,339	10,542	13,252	11,768	8,208	7,648	7,783	4,280	5,945	7,180	73,318		
Min	67	1,238	2,583	2,186	315	0	0	0	0	0	0	0	8,802		

Source: USGS 06828500 Republican River at Stratton, Nebr.

Table 4

Rock Creek Discharge Measurements
Collected by Nebraska DNR
2013

	(1)	(2)				(3)
		Stream Discharge (cfs)				Approximate Stream Distance
	Location	7-Mar	15-Apr	13-May	12-Jun	(miles)
	Head of Rock Creek Augmentation	19.4	25.6	28.7	29.7	0
	Above Rock Creek Fish Hatchery	20.5				1.3
	Below Rock Creek Fish Hatchery	22.3	30	28.8	29	2.3
	Below Rock Creek Lake	27.1	34.6	36.5	31.8	5.2
(4)	USGS 06824000 Rock Creek at Parks, Nebr.	25	29	33	31	11.0

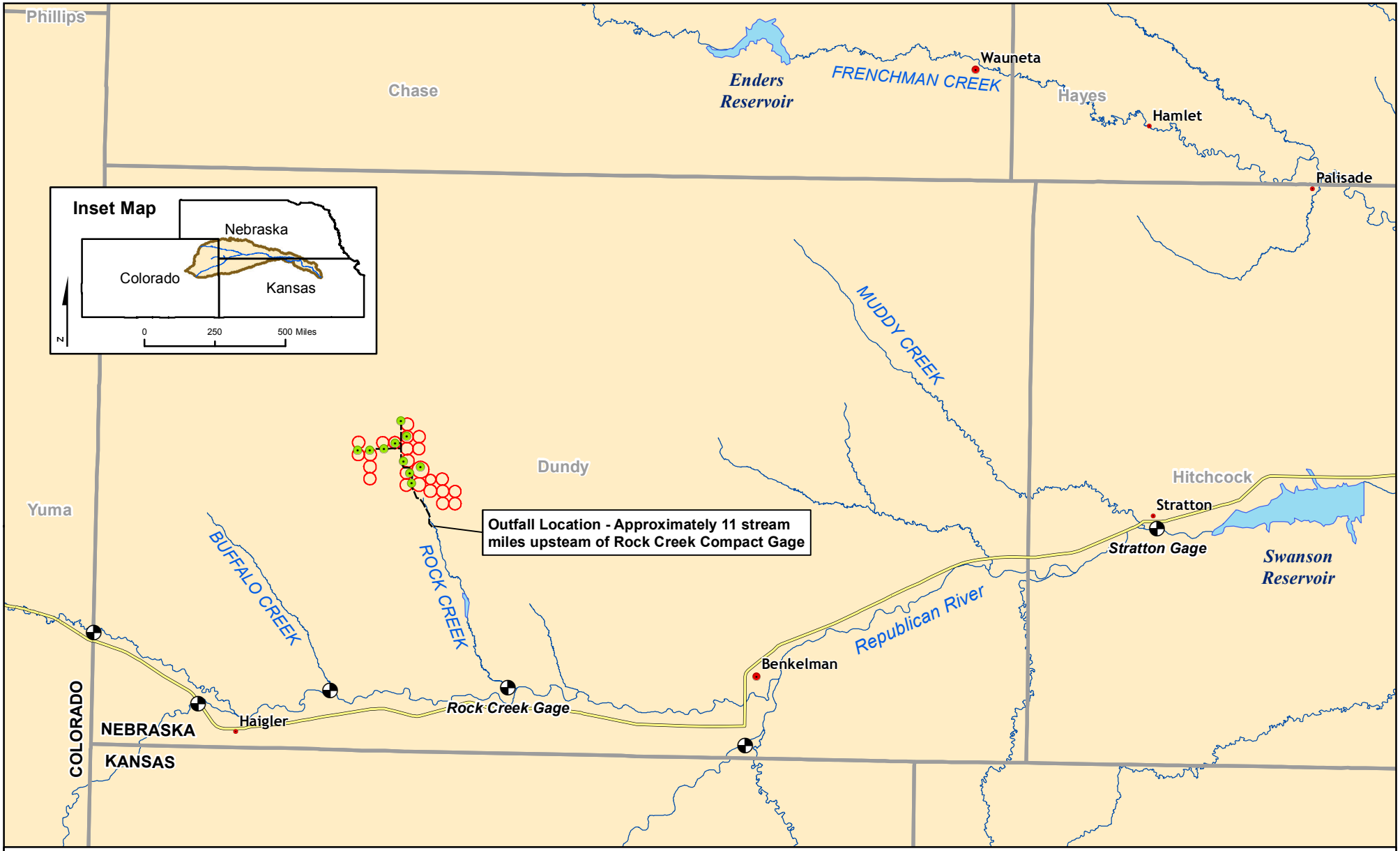
Source: Discharge measurement note sheets provided by Nebraska Attorney General's office on June 26, 2013 and USGS stream gage (0682400) Rock Creek at Parks, Nebraska.

No measurement reported at location shaded in grey.

Notes:

(1) Location of stream measurement described on Nebraska DNR's sheets.
(2) Stream discharge reported on Nebraska DNR's sheets except for Rock Creek at Parks, Nebraska.
(3) Approximate stream distance from Rock Creek Augmentation pipeline outfall, measured in GIS.
(4) Nebraska DNR only measured discharge at the Rock Creek at Parks, Nebraska location on March 7 which approximately matched the USGS stream gage at that location. The USGS stream discharge is reported in the above table.

FIGURES



Source: Nebraska DNR's Rock Creek Augmentation Project proposal, submitted to the RRCA on February 2/8/2013.
USGS Quandrangles

Figure 1

Nebraska's Rock Creek Augmentation Project Location Map

Miles
0 2 4 8 12

- Lands to be Retired
- Augmentation Wells
- Pipeline
- Compact Gages
- US Route 34
- Republican River Basin
- Reservoirs
- County
- Streams

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

7.1.2013

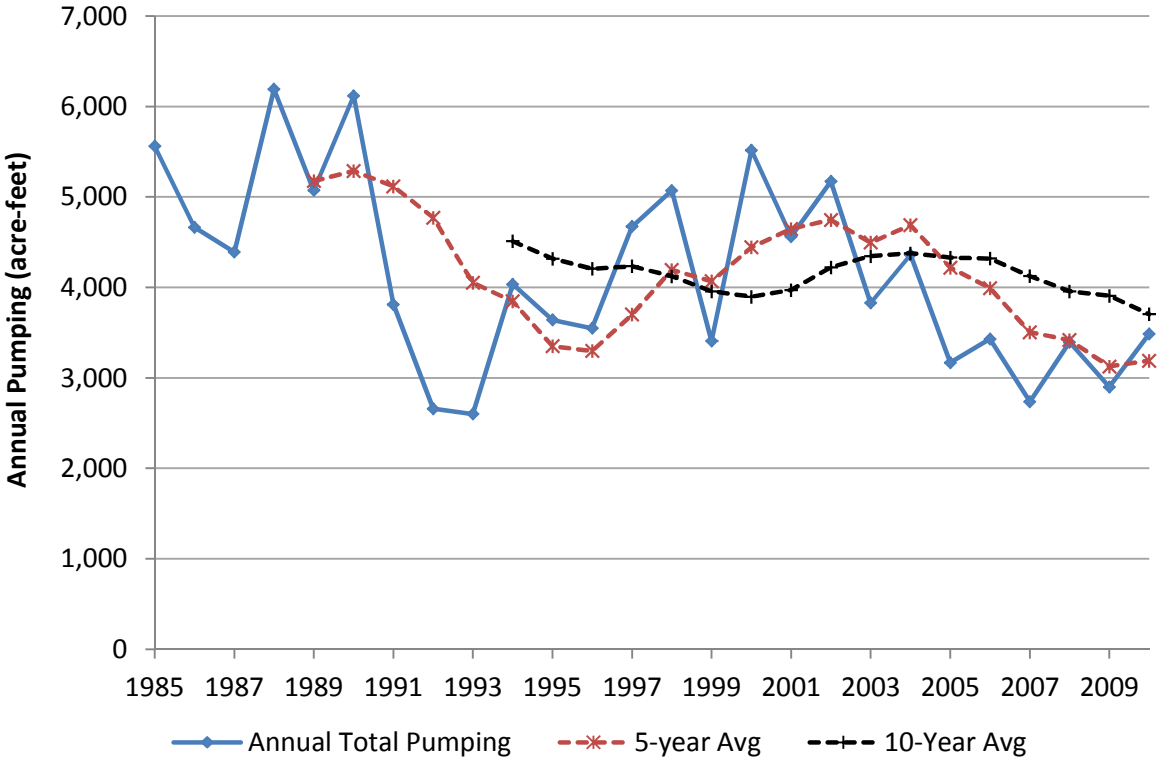
Figure 2

Nebraska Rock Creek Augmentation Project

Historical Pumping for Retired Irrigation Wells

1985 - 2010

acre-feet



Source: Nebraska Upper NRD database (URNRD_KS_RESPONSE.accdb), provided in response to the Kansas discovery request during the Kansas v. Nebraska & Colorado trial (2012).

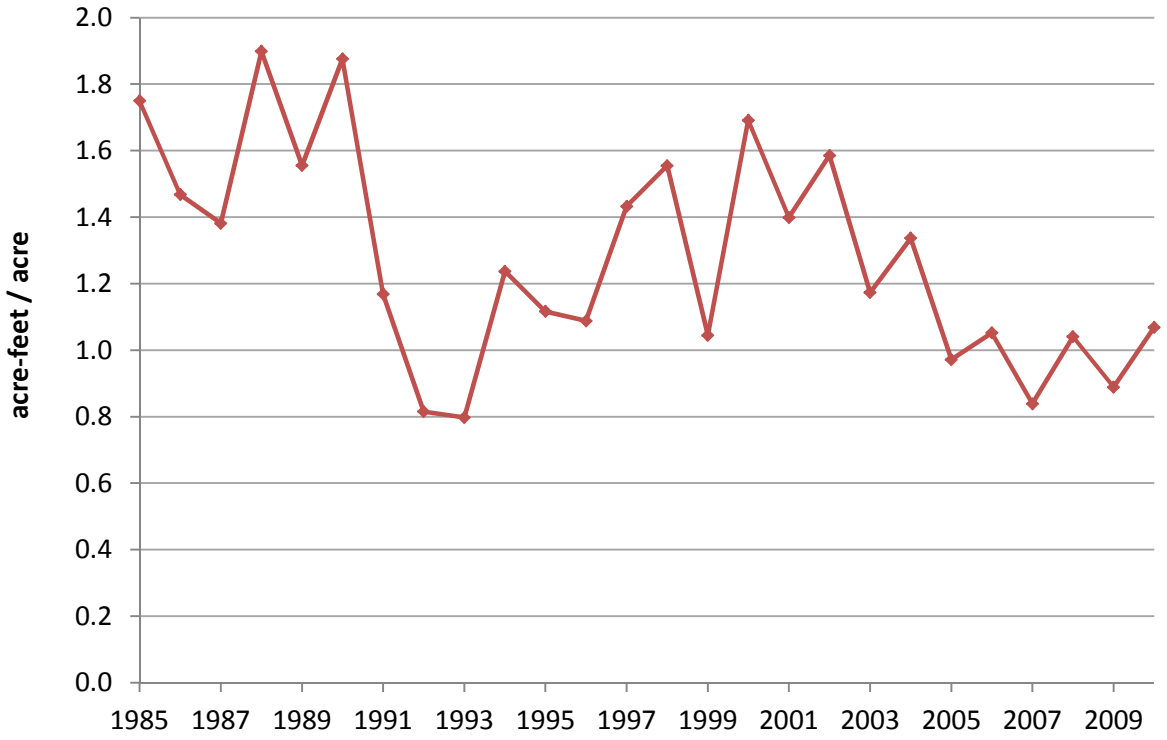
Figure 3

Nebraska Rock Creek Augmentation Project

Annual Application Rate for Retired Irrigation Wells

1985 - 2010

acre-feet/acre



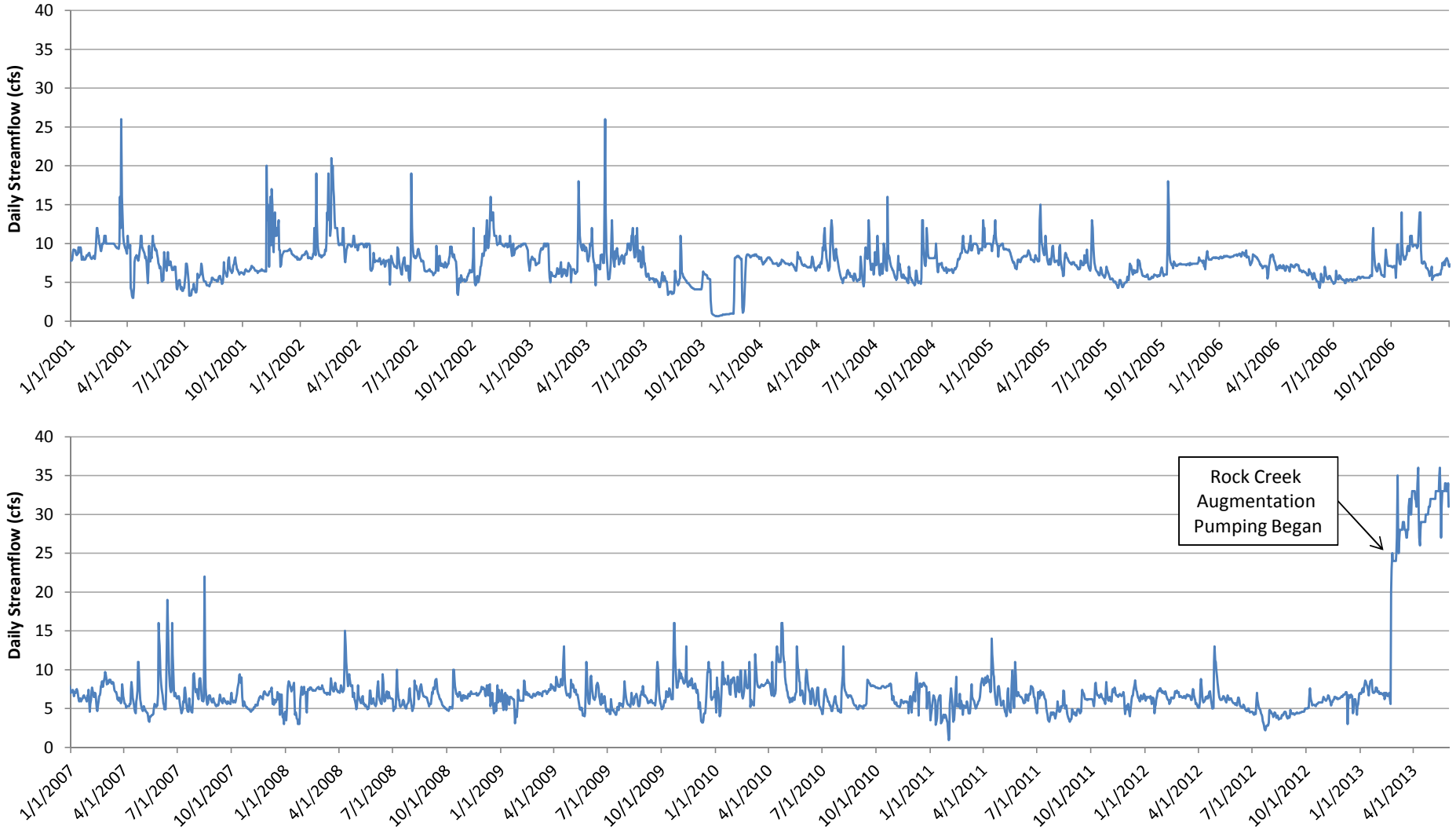
Source: Nebraska Upper NRD database (URNRD_KS_RESPONSE.accdb), provided in response to the Kansas discovery request during the Kansas v. Nebraska & Colorado trial (2012).

Figure 4

Rock Creek Gage Flow

2001 - May, 2013

Daily cfs



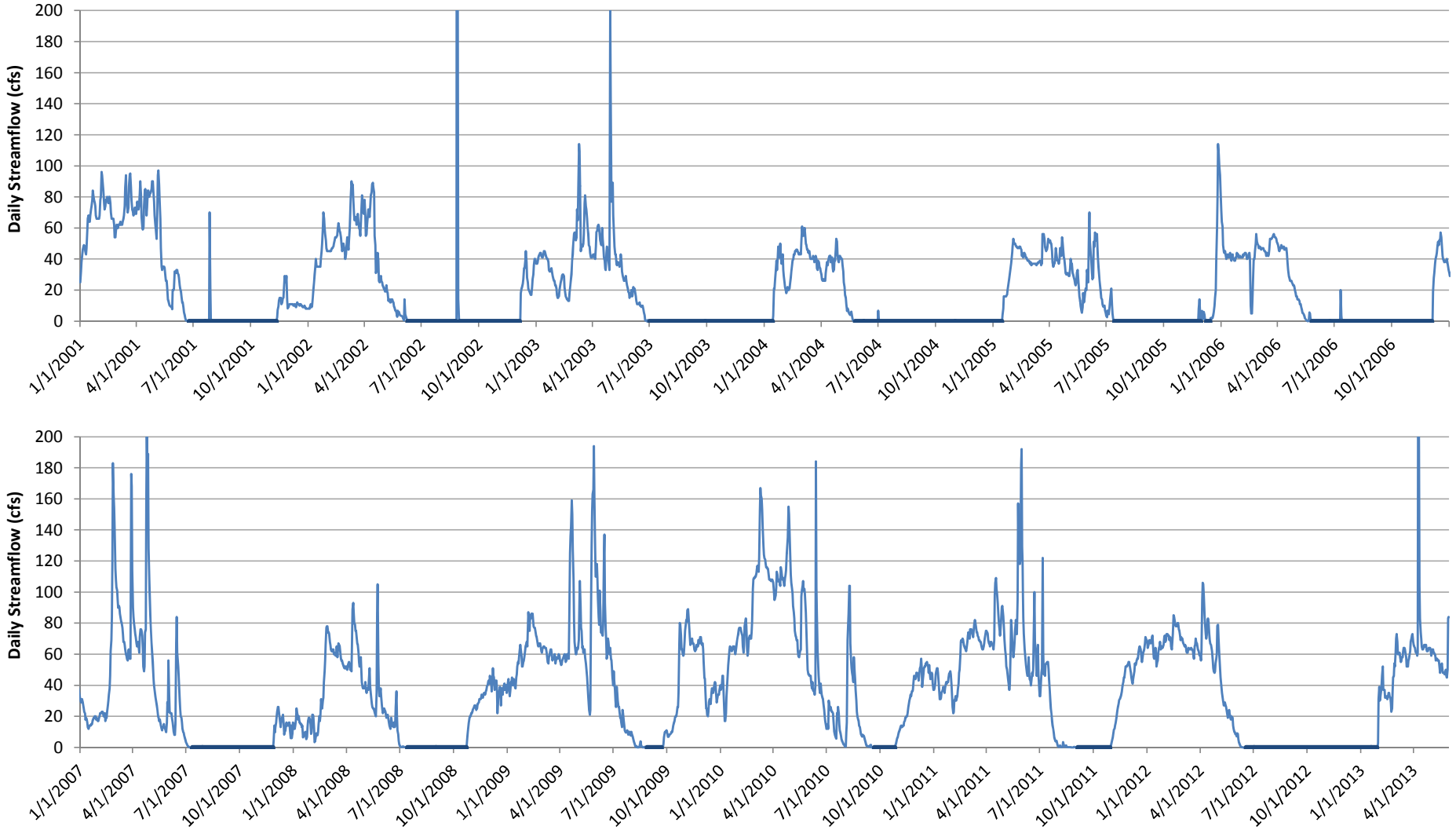
Source: USGS 06824000 Rock Creek at Parks, Nebr.

Figure 5

Republican River at Stratton, Nebraska Gage Flow

2001 - May, 2013

Daily cfs



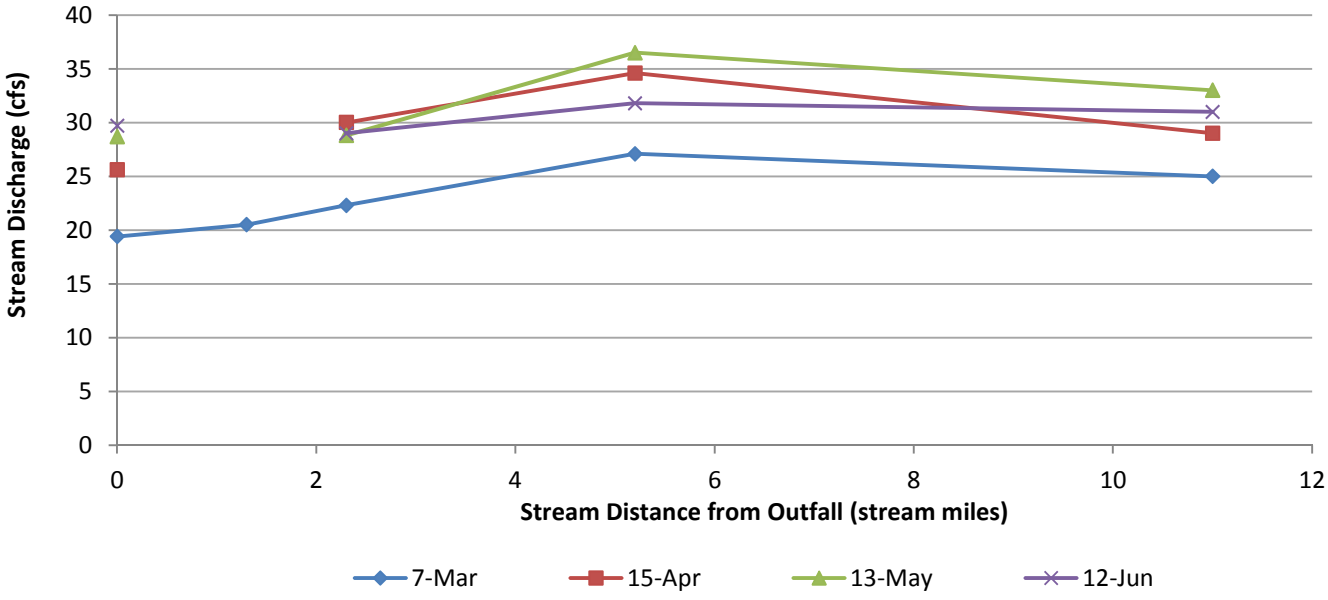
Source: USGS 06828500 Republican River at Stratton, Nebr.

Figure 6

Rock Creek Discharge Measurements

Collected by Nebraska DNR

2013



Location	App. Distance (stream miles)
Head of Rock Creek Augmentation	0
Above Rock Creek Fish Hatchery	1.3
Below Rock Creek Fish Hatchery	2.3
Below Rock Creek Lake	5.2
USGS 06824000 Rock Creek at Parks, Nebr.	11

Source: Discharge measurement note sheets provided by Nebraska Attorney General's office on June 26, 2013 and USGS stream gage (0682400) Rock Creek at Parks, Nebraska.