STATE OF NEBRASKA

Dave Heineman
Governor

DEPARTMENT OF NATURAL RESOURCES
Brian P. Dunnigan, P.E.
Director

February 8, 2013

IN REPLY TO:

David Barfield
Kansas Commissioner, RRCA
Kansas State Engineer
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, KS 66612-1283

Dick Wolfe
Colorado Commissioner, RRCA
Colorado State Engineer
Colorado Division of Water Resources
1313 Sherman Street, Room 818
Denver, CO 80203

RE: Rock Creek Augmentation Project; Submittal to RRCA

Dear Commissioners Barfield and Wolfe:

The State of Nebraska hereby submits its Rock Creek Augmentation Proposal (Proposal) to the RRCA pursuant to Subsection VII.A of the Final Settlement Stipulation. A complete description of the Proposal is set forth in the attached Exhibit A.

Pursuant to Subsection VII.A.3, Nebraska hereby designates this as a "Fast Track" issue and seeks its resolution within the next 30 days. A timeframe for resolution, including non-binding arbitration (if necessary), is included as Exhibit B. Accordingly, Nebraska requests that the Chairman please schedule a Special Meeting of the Republican River Compact Administration on or before March 10, 2013.

Sincerely,

Brian P. Dunnigan, P.E.
Director

Enclosures

cc: John Chaffin, U.S. Department of the Interior
James J. DuBois, U.S. Department of Justice
Col. Anthony J. Hofmann, U.S. Army Corps of Engineers
Aaron M. Thompson, U.S. Bureau of Reclamation

Exhibit A

Rock Creek Augmentation Project

Rock Creek Augmentation Project

Submitted to the Republican River Compact Administration

February 8, 2013

Nebraska
Department of Natural Resources

I. Project Background and FSS Requirements for Augmentation Projects

The Upper Republican Natural Resources District (URNRD) is developing the Rock Creek Augmentation Project (Project) located in southwest Nebraska (Figure 1). The purpose of this project is to assist Nebraska in maintaining compliance with the Republican River Compact (Compact). The Project involves the retirement of the 23 existing irrigation wells and the 3,262 certified irrigated acres those wells irrigated. Ten augmentation wells were drilled for the project, replacing the irrigation wells and providing an optimized capacity and spatial distribution to match the design capacity of the Project. The lands that were previously cropped are being seeded back to natural grasses. Groundwater pumped from the new augmentation wells will be delivered by means of a pipeline that spans the approximately six miles from the wells to the discharge location directly into Rock Creek.

The Final Settlement Stipulation (FSS) specifically recognizes augmentation as a management tool to facilitate Compact compliance. Augmentation is referenced in three locations throughout the FSS. The first occurs in Section III in the list of exceptions to the moratorium on new wells. Subsection III.B.1.k., states that the moratorium on new wells shall not apply to the following:

> *Wells acquired or constructed by a State for the sole purpose of offsetting stream depletions in order to comply with its Compact Allocations. Provided that, such Wells shall not cause any new net depletion to stream flow either annually or long-term. The determination of net depletions from these Wells will be computed by the RRCA Groundwater Model and included in the State's Computed Beneficial Consumptive Use.* ***Augmentation plans*** *and related accounting procedures submitted under this Subsection III.B.1.k. shall be approved by the RRCA prior to implementation.*

The second and third references to augmentation occur in Section IV, which lays out the provisions for Compact accounting under the FSS. Subsection IV.A. states:

> *The States will determine Virgin Water Supply, Computed Water Supply, Allocations, Imported Water Supply Credit,* ***augmentation credit*** *and Computed Beneficial Consumptive Use based on a methodology set forth in the RRCA Accounting Procedures, attached hereto as Appendix C.*

There presently are no "methodologies" set forth in the Republican River Compact Administration (RRCA) Accounting Procedures and Reporting Requirements (Accounting Procedures) to determine the augmentation credit referenced in Subsection IV.A. The only additional guidance in the FSS is found in Subsection IV.H., which states:

> ***Augmentation credit****, as further described in Subsection III.B.1.k., shall be calculated in accordance with the RRCA Accounting Procedures and by using the RRCA Groundwater Model.*

Finally, Subsection I.F. of the FSS provides:

The RRCA may modify the RRCA Accounting Procedures, or any portion thereof, in any manner consistent with the Compact and this Stipulation.

Taken together, these references suggest the following:

1. If the project involves the acquisition or construction of augmentation wells in the moratorium area, those wells may not cause a "new" net depletion either annually or over the "long-term."

2. The RRCA Groundwater Model (Model) will be used to determine the extent of any net depletion and whether such net depletion is "new."

3. The Accounting Procedures will be revised to reflect the appropriate methodology for calculating the augmentation credit.

4. The Model will be used to calculate the credit, assuming, of course, that the project involves an activity that implicates groundwater Computed Beneficial Consumptive Use (CBCU).

5. The RRCA must approve any augmentation plan and related accounting procedures before a state may receive "augmentation credit" for the project, beyond the effect of simply increasing water supply, which will manifest itself in the current Accounting Procedures.

The States elaborated on these concepts before Special Master Vincent McKusick in 2003. (Transcript at 81-3; id. at 16-17.) Using the example there provided, a State would be entitled to claim as an "augmentation credit" all water pumped to the stream.

II. Baseline Conditions of the Project Area

This section describes the conditions of the project area prior to the acquisition of lands to implement the Project (Figure 2). Tables 1 and 2 provide information on the historical pumping and certified irrigated acreage of the 23 wells which were retired and decommissioned when the land acquisition was made. The cropped lands (irrigated acres and dryland acres) that were acquired as part of this project will be seeded back to natural grasses and irrigation that previously occurred will be retired permanently.

III. Operational Aspects of the Project

This section describes the operational conditions of the Project (see Figure 3). The new augmentation wells developed as part of the Project will be used to offset stream depletions to assist the State of Nebraska with Compact compliance efforts. The actual amount delivered in any one year will be subject to current conditions affecting Nebraska's Compact compliance outlook and on ensuring that no new net depletion is associated with the project. Thus, Project operations will fall into two categories: 1) Annual operations to support Compact compliance efforts (Compact Operations Years) and 2) Annual operations specially designed to ensure that no new net depletions occur (Maintenance Operations Years) during those years when the Project is not needed to support Compact compliance efforts.

The groundwater pumping associated with the new augmentation wells will be incorporated into the Model on an annual basis and charged as groundwater CBCU by the State of Nebraska. The detailed analysis of potential net depletions associated with project operations relative to historical conditions, and an operational pattern that would have prevented the occurrence of any new net depletions, is described in Section IV.

The augmentation water delivered to Rock Creek via the Project pipeline will be measured and incorporated into the Accounting Procedures. Details of the Accounting Procedure modifications necessary to properly account for the Augmentation Water Supply (AWS) Credit are described in Section V and Appendix A.

IV. Groundwater Modeling Analysis of the Project

This section describes the evaluation of any change in the groundwater CBCU with respect to potential augmentation deliveries. Any increase in groundwater CBCU, or new depletion, is compared to the augmentation deliveries to assess the net impact of the project operations on streamflows of the Republican River Basin. The new depletion is determined by comparing the groundwater CBCU under the baseline (i.e., groundwater pumping for irrigation in the Project area) simulation of the Model to the groundwater CBCU that results from a Model simulation with the Project operating under this augmentation plan. Finally, any new depletion is compared to the AWS Credit in that same year to determine the net depletion to streamflow. The analysis in this section evaluates operations under a historical period, operations under a hypothetical future scenario, and a tracking system that will ensure no new net depletions as the project is operated going forward.

A. Net Depletions of Project Operations When Assessed Against Historical Baseline Conditions

This analysis evaluates hypothetical Project operations under historical circumstances that may have warranted operation- of the Project. The 1985-2010 period was chosen for this analysis to represent a reasonably long historic period as well as capture multiple cycles of Compact Operation Years. The historic groundwater CBCU under baseline Project conditions is represented by the Model simulations for the period 1985 through 2010 (26 years). The Model files used in this baseline simulation were intended to be consistent with the historical files developed for assisting with the RRCA annual accounting. These same Model simulations were then updated to reflect how Project operations may have functioned through this period. The key difference for the Model simulation of Project operations is that the historical recharge and groundwater pumping were modified for those Model cells which correspond to the Project area. The recharge in the modified historical simulation differed from the recharge in the historical simulation in that the baseline recharge was modified to remove the additional recharge associated with Project irrigated lands for the entire simulation period.

The Project has the capacity to provide an augmentation delivery of up to 20,000 acre-feet in a given year. In this example, the baseline pumping conditions were modified in a manner that reduced groundwater pumping to 300 acre-feet during Maintenance Operations Years (17 of 26 years) and modified groundwater pumping to reflect a volume of 15,000 acre-feet during Compact Operations Years (Table 3). The 15,000 acre-feet value is intended to serve as a representative average value of typical Compact Operations Years. The minimum pumping value of 300 acre-feet was adopted as the Maintenance Operations Year pumping volume in this scenario because it was determined to be more than sufficient to offset any new depletion related to Compact Operations Years. Documentation and model files for this simulation are contained in Appendix B.

The Compact Operations Years include: 1988-1991 and 2002-2006. The Maintenance Operations Years for the simulation include: 1985-1987, 1992-2001, and 2007-2010. The Compact Operations Years were chosen from the historical record as they represent periods of lower water supplies when it is more likely that the project would be operated to offset a projected shortfall in Nebraska's Compact balance. The results of the historical simulation under Project operations, as compared to historical operations, are summarized in Table 4 and Figure 4. Under the Project operations described in Table 3, the Project would not cause a new net depletion in any of the historic years as shown in Table 4.

B. *Net Depletions of Project Operations When Assessed Against Future Baseline Conditions*

The second analysis of Project operations was to evaluate a hypothetical future scenario. While the process Nebraska intends to use to annually track net depletions of the Project will ensure the standard of no new net depletions is met each and every year now and into the future, a future scenario was developed to address questions or concerns that may be raised by the other States. This scenario was developed from a hypothetical future scenario first created by the State of Kansas. This scenario was utilized by Kansas for expert reports generated in 2011 for Kansas v. Nebraska and Colorado, Original No. 126. It is recognized that this scenario represents one of an infinite number of potential future scenarios and in no way serves as a barometer of what future conditions may be. Moreover, this analysis is simply presented to illustrate how net depletions may be manifest over the long term.

This portion of the analysis was completed by comparing the results of a simulation of hypothetical future conditions for the period 2010-2069 for the following conditions: 1) the certified irrigated acres continue to be irrigated in a manner consistent with the historical hydrology with some consideration for current regulations; and 2) with the irrigation removed and the project operated to provide augmentation deliveries. This hypothetical future scenario was developed by repeating the years 1995-2009 four times into the future. The key difference for the simulation of project operations is that the recharge due to irrigation and groundwater pumping were modified for those model cells which correspond to the project area. The modified simulation differed from the “baseline” (unchanged) simulation in that the baseline recharge was modified to remove the additional recharge associated with project irrigated lands for the entire simulation period.

The baseline pumping conditions were modified in a manner that reduced groundwater pumping to 300 acre-feet during Maintenance Operations Years (40 of 60 years) and modified groundwater pumping to reflect a volume of 15,000 acre-feet during Compact Operations Years (Table 5). The results of the future simulation of new depletions and the net depletion given the AWS credit for each year are summarized in Table 6 and Figure 5. Documentation and model files for this simulation are contained in Appendix B.

As demonstrated by the results in Table 6, the net depletions are always negative for this scenario, indicating the AWS Credit is always greater than the new depletion and streamflow is increased by that value. Therefore, the pumping volume of 300 acre-feet per year for the Maintenance Operations Years is sufficient to ensure no new net depletions in this hypothetical future scenario. As stated above, this value would be adjusted as necessary to ensure no new net depletions in every year.

C. *Process for Tracking Net Depletions and Determining Future Pumping During Maintenance Operations Years to Ensure No New Net Depletions*

In the previous examples, the net depletions could be analyzed for the entire time period and a pumping volume chosen for the Maintenance Operations Years such that the project would not cause any new net depletion. For project operations going forward under this plan, a process is needed to be able to track any new depletions caused by the project operations to determine a sufficient pumping volume for the Maintenance Operations Years to ensure no new net depletions in those years. The following process will achieve that result.

The historic groundwater pumping for irrigation at the project site is well documented (Table 1). Therefore, while the official Model runs will incorporate the actual pumping that occurs in any given year, Nebraska will perform additional Model simulations to determine any new depletions that may occur each year due to the Project operations above those that would have existed had the Project remained under its historical operations (irrigated agriculture). These model simulations will essentially involve constructing an additional model scenario for each year that reflects the average historical irrigation pumping and irrigation recharge. The difference in the groundwater CBCU in this hypothetical simulation relative to the official Model runs will represent the increase (or decrease) in depletions as a result of the Project.

These simulations will only provide an indication of the new depletions that occurred under project operations after a given year has ended. However, the pumping volume during a Maintenance Operations Year would need to be determined at the beginning of that year. Therefore, the pumping volume that will occur in a Maintenance Operations Year will be based on the maximum new depletion observed from project operations over time. This maximum value will be adjusted accordingly to account for potential increases in new depletions in that year over and above the historical observed maximum. In no event will the Maintenance Operation Year pumping be less than 300 acre-feet.

Nebraska will notify the states prior to the initiation of Project operations in the upcoming year to inform them of the volume of water that is intended to be pumped by the Project. Additionally, the Model runs conducted by Nebraska to determine the Maintenance Operations Year pumping will be exchanged with the other states during the annual data exchange. This additional element of the annual data exchange is set forth in Appendix A and reflects the fact that the State of Nebraska would annually report on the operations of the Project.

V. RRCA Accounting Procedure Modifications for Augmentation Credit Calculations

The examples above demonstrate how the Model would be used to determine any new depletion from the operation of the Project. This section describes the modifications to the Accounting Procedures needed to determine the augmentation credit to be provided in conjunction with the Project. The August 12, 2010, version of the Accounting Procedures are included as Appendix A, with the modifications required to implement this proposal indicated in red-line format. Below is an example of the current RRCA sub-basin calculations for determining the Virgin Water Supply (VWS) as well as the necessary modifications to account for the AWS and any new depletion caused by the Project.

Current Accounting Procedures Formula for Calculating Rock Creek Subbasin Virgin Water Supply:

VWS = Gage + All CBCU – IWS

VWS = 1,000 + 1,000 + 0 – 0 = 2,000

Nebraska Allocation = 0.6934[1] * 2,000 = 1,386.8

Kansas Allocation = 0.3066 * 2,000 = 613.2

Nebraska Balance in Rock Creek Subbasin = Nebraska Allocation – Nebraska CBCU = 1,386.8 – 1,000[2] = 386.8

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[1] The allocation percentages for both Nebraska and Kansas include the each states share of the unallocated water supply and that the VWS is equivalent to the CWS (i.e., no flood flows included).
[2] Assumes all CBCU is assigned to Nebraska.

Proposed RRCA Accounting Procedures to include Augmentation Water Supply Credit (with Project operations of 300 acre-feet and an additional groundwater depletion of 5 acre-feet):

Gage + All CBCU – IWS – AWS

VWS = 1,295 + [1,005 - 300] + 0 – 0 = 2,000

Nebraska Allocation = 0.6934 * 2,000 = 1,386.8

Kansas Allocation = 0.3066 * 2,000 = 613.2

Nebraska Balance in Rock Creek Subbasin = Nebraska Allocation – Nebraska CBCU + AWS Credit = 1,386.8 – 1,005 + 300 = 681.8

The Main Stem accounting procedures would remain unchanged as the necessary modifications are reflected in the Designated Drainage Basin[3] where the Augmentation Plan is being implemented. Examples of the impact of the AWS Credit on the final Compact Accounting Balance for Tables 3C and 5C are illustrated below (Tables 7 and 8)[4]. Similar modifications to those made to Tables 3C and 5C of the Accounting Procedures would also be made to Tables 5D and 5E.

VI. Summary

This report has described the required elements of an augmentation plan pursuant to the requirements set forth in the FSS. Nebraska has included additional elements within this plan, beyond those strictly required by the FSS, to accommodate previous comments provided by the other states as wells as any concerns the states may have related to data sharing and future tracking of project operations. Nebraska submits this plan with time being of the essence and seeks the good faith efforts of the states in working to implement this plan in a timely fashion.

[3] As defined in the Accounting Procedures pg. 6.
[4] The values contained in Tables 7 and 8 are for illustrative purposes only.

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

Table 1. Historical Pumping 1985-2010 (ac-ft)

WellID	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg
49222	263	113	263	242	267	213	156	215	204	129	210	167	199	194
49223	118	112	183	223	280	163	244	115	185	157	80	88	68	155
49224	119	178	259	231	280	152	248	110	56	14	63	47	223	160
49225	349	228	355	302	351	376	288	32	130	137	195	146	114	222
49226	213	154	194	90	271	202	211	156	83	104	100	55	58	172
49227	223	149	212	103	33	143	213	144	183	164	135	39	150	166
49228	239	156	201	88	253	203	224	175	85	123	104	80	65	167
49229	221	165	210	94	110	141	189	139	184	186	182	143	188	174
49244	200	199	295	283	312	183	301	257	261	224	238	199	223	241
49245	169	169	182	176	81	154	150	113	71	95	103	71	75	162
49246	228	104	225	224	179	210	223	193	163	57	222	191	235	186
49367	177	171	160	170	206	210	222	97	230	212	217	192	218	199
49368	219	97	218	202	163	42	75	183	124	49	186	158	188	173
49369	496	236	512	431	487	396	334	18	144	115	148	105	85	304
49370	239	114	267	227	267	210	160	189	181	190	201	157	186	193
49472	148	142	230	218	255	131	252	114	221	178	207	172	215	188
51544	222	89	215	210	169	39	8	109	96	44	66	149	172	149
51545	226	102	227	218	180	45	48	155	143	50	211	166	215	172
51546	225	145	223	160	125	43	76	184	177	73	75	172	213	151
51722	141	164	263	225	275	207	259	128	157	140	150	190	185	183
51723	207	144	226	159	122	29	38	8	92	35	32	51	22	112
51724	213	143	184	82	256	191	207	151	65	88	80	0	0	153
52006	215	134	211	201	248	143	236	184	197	173	188	161	192	180
Total	5,070	3,407	5,517	4,562	5,171	3,827	4,360	3,168	3,430	2,736	3,393	2,900	3,486	4,154

Table 1 (Continued). Historical Pumping 1985-2010 (ac-ft)

WellID	2010 Certified Acres
49222	130.7
49223	133.8
49224	130.1
49225	224.7
49226	128.4
49227	133.6
49228	133.8
49229	132.8
49244	155.0
49245	132.3
49246	134.6
49367	128.0
49368	133.7
49369	251.0
49370	129.8
49472	134.0
51544	127.2
51545	124.8
51546	129.3
51722	132.4
51723	133.5
51724	133.4
52006	134.7
Total	3,261.6

Table 2. Historical Certified Acres.

Year	Type of Operation Year	Groundwater Pumping under Project Operations
1985	Maintenance	300
1986	Maintenance	300
1987	Maintenance	300
1988	Compact	15,000
1989	Compact	15,000
1990	Compact	15,000
1991	Compact	15,000
1992	Maintenance	300
1993	Maintenance	300
1994	Maintenance	300
1995	Maintenance	300
1996	Maintenance	300
1997	Maintenance	300
1998	Maintenance	300
1999	Maintenance	300
2000	Maintenance	300
2001	Maintenance	300
2002	Compact	15,000
2003	Compact	15,000
2004	Compact	15,000
2005	Compact	15,000
2006	Compact	15,000
2007	Maintenance	300
2008	Maintenance	300
2009	Maintenance	300
2010	Maintenance	300

Table 3. Groundwater pumping incorporated into the historical project operations simulation.

Year	New Depletion	AWS Credit	Net Depletion
1985	-4	-300	-304
1986	-29	-300	-329
1987	-54	-300	-354
1988	-60	-15,000	-15,060
1989	-27	-15,000	-15,027
1990	-40	-15,000	-15,040
1991	-8	-15,000	-15,008
1992	66	-300	-234
1993	144	-300	-156
1994	278	-300	-22
1995	171	-300	-129
1996	187	-300	-113
1997	174	-300	-126
1998	199	-300	-101
1999	173	-300	-127
2000	138	-300	-162
2001	13	-300	-287
2002	25	-15,000	-14,975
2003	-11	-15,000	-15,011
2004	0	-15,000	-15,000
2005	64	-15,000	-14,936
2006	118	-15,000	-14,882
2007	183	-300	-117
2008	233	-300	-67
2009	288	-300	-12
2010	261	-300	-39

Table 4. Simulated new depletion under project operations groundwater pumping, AWS credit, and the net depletions of project operation on the stream (negative depletion values indicate an accretion to streamflow). Net Depletion = New AWS credit + New Depletion.

Year	Type of Operation Year	Groundwater Pumping under Project Operations
2010	Maintenance	300
2011	Maintenance	300
2012	Maintenance	300
2013	Maintenance	300
2014	Maintenance	300
2015	Maintenance	300
2016	Maintenance	300
2017	Compact	15,000
2018	Compact	15,000
2019	Compact	15,000
2020	Compact	15,000
2021	Compact	15,000
2022	Maintenance	300
2023	Maintenance	300
2024	Maintenance	300
2025	Maintenance	300
2026	Maintenance	300
2027	Maintenance	300
2028	Maintenance	300
2029	Maintenance	300
2030	Maintenance	300
2031	Maintenance	300
2032	Compact	15,000
2033	Compact	15,000
2034	Compact	15,000
2035	Compact	15,000
2036	Compact	15,000
2037	Maintenance	300
2038	Maintenance	300
2039	Maintenance	300
2040	Maintenance	300
2041	Maintenance	300
2042	Maintenance	300

Table 5. Groundwater pumping incorporated into the future project operations simulation.

Year	Type of Operation Year	Groundwater Pumping under Project Operations
2043	Maintenance	300
2044	Maintenance	300
2045	Maintenance	300
2046	Maintenance	300
2047	Compact	15,000
2048	Compact	15,000
2049	Compact	15,000
2050	Compact	15,000
2051	Compact	15,000
2052	Maintenance	300
2053	Maintenance	300
2054	Maintenance	300
2055	Maintenance	300
2056	Maintenance	300
2057	Maintenance	300
2058	Maintenance	300
2059	Maintenance	300
2060	Maintenance	300
2061	Maintenance	300
2062	Compact	15,000
2063	Compact	15,000
2064	Compact	15,000
2065	Compact	15,000
2066	Compact	15,000
2067	Maintenance	300
2068	Maintenance	300
2069	Maintenance	300

Table 5 (Continued). Groundwater pumping incorporated into the future project operations simulation.

Year	New Depletion	AWS Credit	Net Depletion
2010	-1	-300	-301
2011	-24	-300	-324
2012	-40	-300	-340
2013	-60	-300	-360
2014	-119	-300	-419
2015	-106	-300	-406
2016	-152	-300	-452
2017	-100	-15,000	-15,100
2018	-120	-15,000	-15,120
2019	-100	-15,000	-15,100
2020	-99	-15,000	-15,099
2021	-71	-15,000	-15,071
2022	-56	-300	-356
2023	-30	-300	-330
2024	-1	-300	-301
2025	15	-300	-285
2026	37	-300	-263
2027	35	-300	-265
2028	31	-300	-269
2029	48	-300	-252
2030	23	-300	-277
2031	26	-300	-274
2032	13	-15,000	-14,987
2033	7	-15,000	-14,993
2034	-2	-15,000	-15,002
2035	7	-15,000	-14,993
2036	19	-15,000	-14,981
2037	47	-300	-253
2038	72	-300	-228
2039	124	-300	-176
2040	100	-300	-200

Table 6. Simulated future new depletion under project operations groundwater pumping, AWS credit, and the net depletions of project operation on the stream (negative depletion values indicate an accretion to streamflow). Net Depletion = AWS credit + New Depletion.

Year	New Depletion	AWS Credit	Net Depletion
2041	160	-300	-140
2042	122	-300	-178
2043	94	-300	-206
2044	188	-300	-112
2045	73	-300	-227
2046	117	-300	-183
2047	97	-15,000	-14,903
2048	87	-15,000	-14,913
2049	101	-15,000	-14,899
2050	115	-15,000	-14,885
2051	94	-15,000	-14,906
2052	146	-300	-154
2053	161	-300	-139
2054	242	-300	-58
2055	134	-300	-166
2056	291	-300	-9
2057	170	-300	-130
2058	180	-300	-120
2059	284	-300	-16
2060	136	-300	-164
2061	187	-300	-113
2062	130	-15,000	-14,870
2063	109	-15,000	-14,891
2064	80	-15,000	-14,920
2065	174	-15,000	-14,826
2066	118	-15,000	-14,882
2067	163	-300	-137
2068	176	-300	-124
2069	284	-300	-16

Table 6 (Continued). Simulated future new depletion under project operations groundwater pumping, AWS credit, and the net depletions of project operation on the stream (negative depletion values indicate an accretion to streamflow). Net Depletion = AWS credit + New Depletion.

Nebraska				
	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive Use	Imported Water Supply Credit **and/or Augmentation Water Supply Credit**	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit and/or Augmentation Water Supply Credit Col 1 – (Col 2- Col 3)
Year 2002	236,550 236,550	265,910 265,910	13,996 13,996	-15,364 -15,364
Year 2003	227,580 227,580	262,780 262,780	9,782 9,782	-25,418 -25,418
Year 2004	205,630 205,630	252,650 252,650	10,386 10,386	-36,634 -36,634
Year 2005	199,450 199,450	**253 ,940** 253,740	**26,965** 11,965	**-27,525** -42,325
Current Year 2006	187,090 187,090	**228,620** 228,420	**27,214** 12,214	**-14,316** -29,116
Average	211,260 211,260	**252,780** 252,700	**17,670** 11,670	**-23,850** -29,770

Table 7. Example of RRCA Accounting Procedure Table 3C Results with the Augmentation Water Supply Credit (top values in each column) and without the Augmentation Water Supply Credit (bottom values in each column). The gray shaded years (2005-2006) represent Compact Operation Years in which hypothetical new depletions (200 acre-feet) and deliveries (15,000 acre-feet) of operating the project are superimposed on the historical accounting data. Bold values represent data values that differ from the historical values due to project operations.

Nebraska								
Year	Allocation			Computed Beneficial Consumptive Use			Imported Water Supply Credit **and/or Augmentation Water Supply Credit**	Difference Between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit and/or Augmentation Water Supply Credit Above Guide Rock
Column	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU below Guide Rock	State Wide CBCU above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
Previous Year	199,450 199,450	4,586 4,586	194,864 194,864	**253,940** 253,740	4,052 4,052	**249,889** 249,689	**26,965** 11,965	**-28,060** -44,234
Current Year	187,090 187,090	2,286 2,286	184,804 184,804	**228.62** 228,420	3,057 3,057	**225,563** 225,363	**27,214** 12,214	**-13,545** -28,345
Average	193,270 193,270	2,286 3,440	189,830 189,830	**241,280** 241,080	3,550 3,550	**237,730** 237,530	**27,090** 12,090	**-20,800** -36,290

Table 8. Example of RRCA Accounting Procedure Table 5C Results with the Augmentation Water Supply Credit (top values in each column) and without the Augmentation Water Supply Credit (bottom values in each column). The gray shaded years (2005-2006) represent Compact Operation Years in which hypothetical new depletions (200 acre-feet) and deliveries (15,000 acre-feet) of operating the project are superimposed on the historical accounting data. Bold values represent data values that differ from the historical values due to project operations.

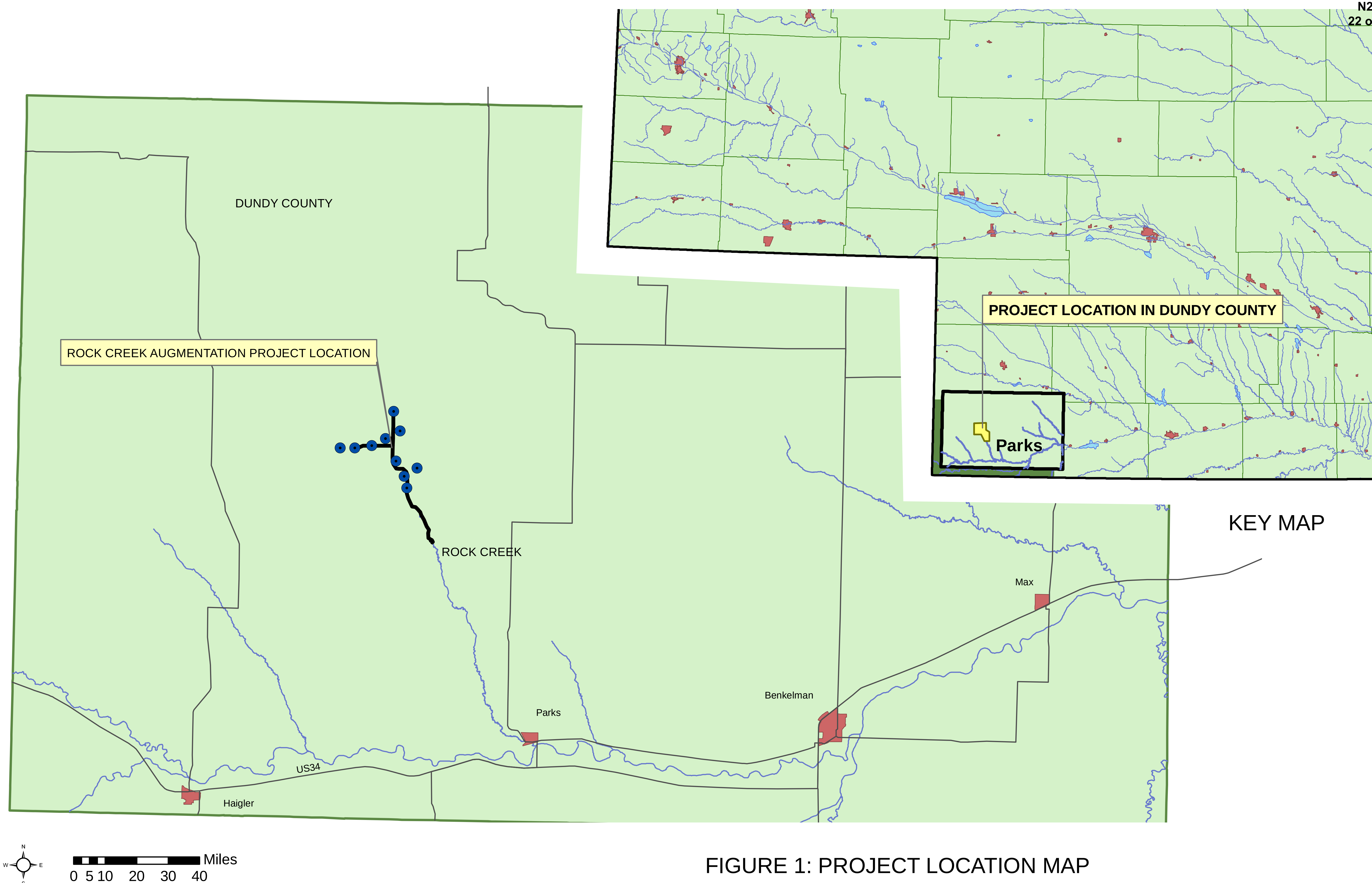


FIGURE 1: PROJECT LOCATION MAP

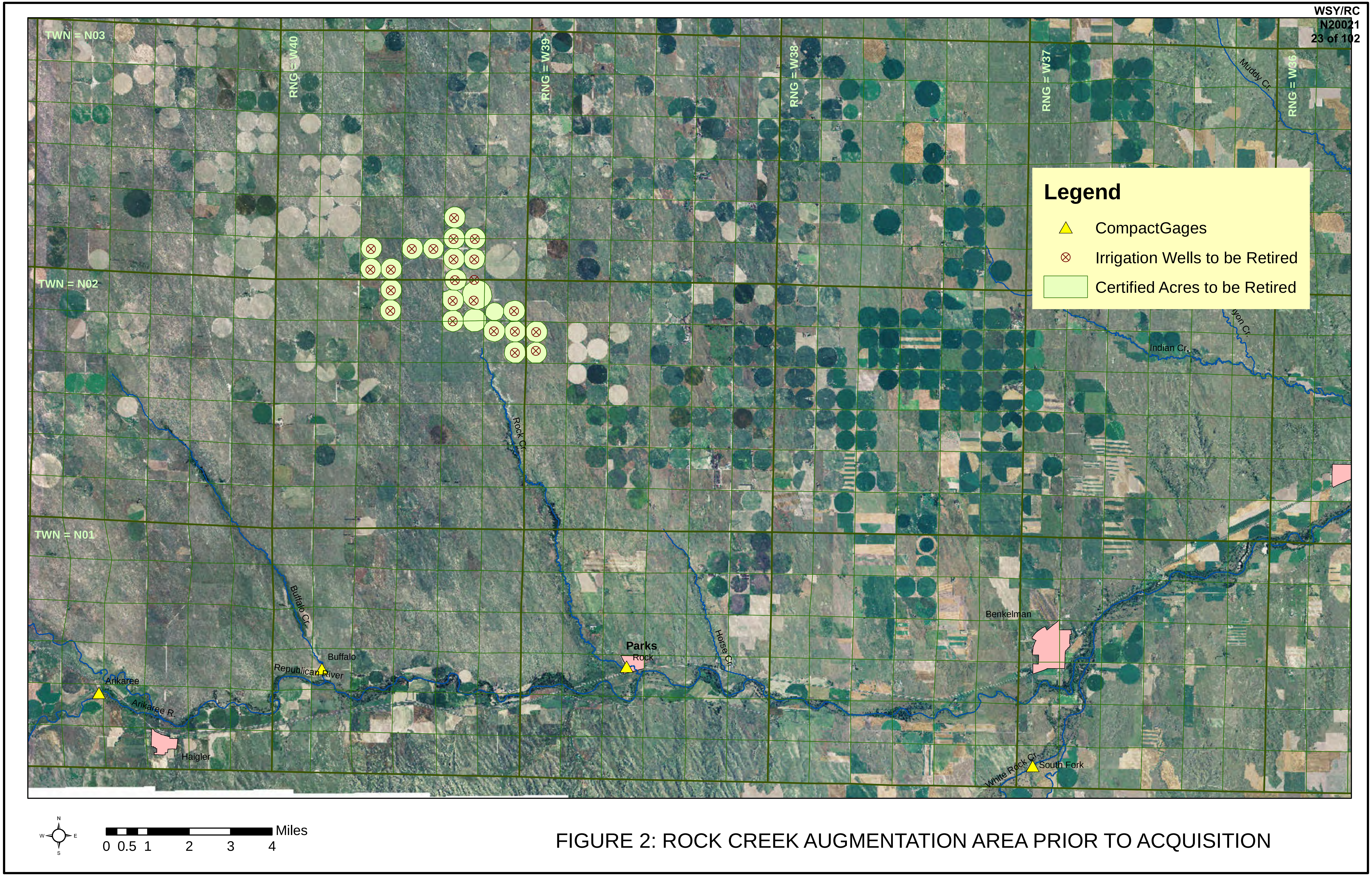


FIGURE 2: ROCK CREEK AUGMENTATION AREA PRIOR TO ACQUISITION

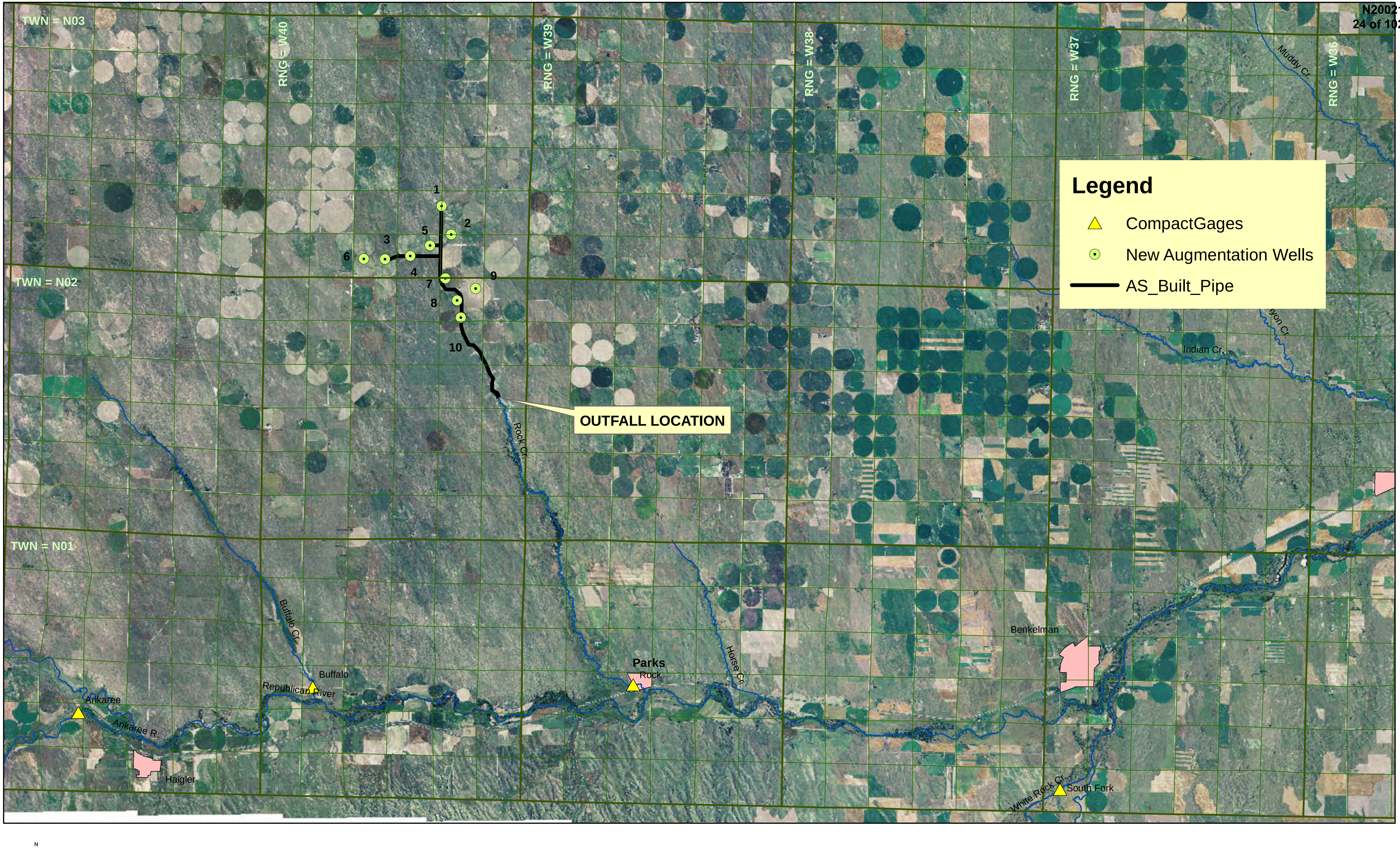


FIGURE 3: ROCK CREEK AUGMENTATION PROJECT PLAN

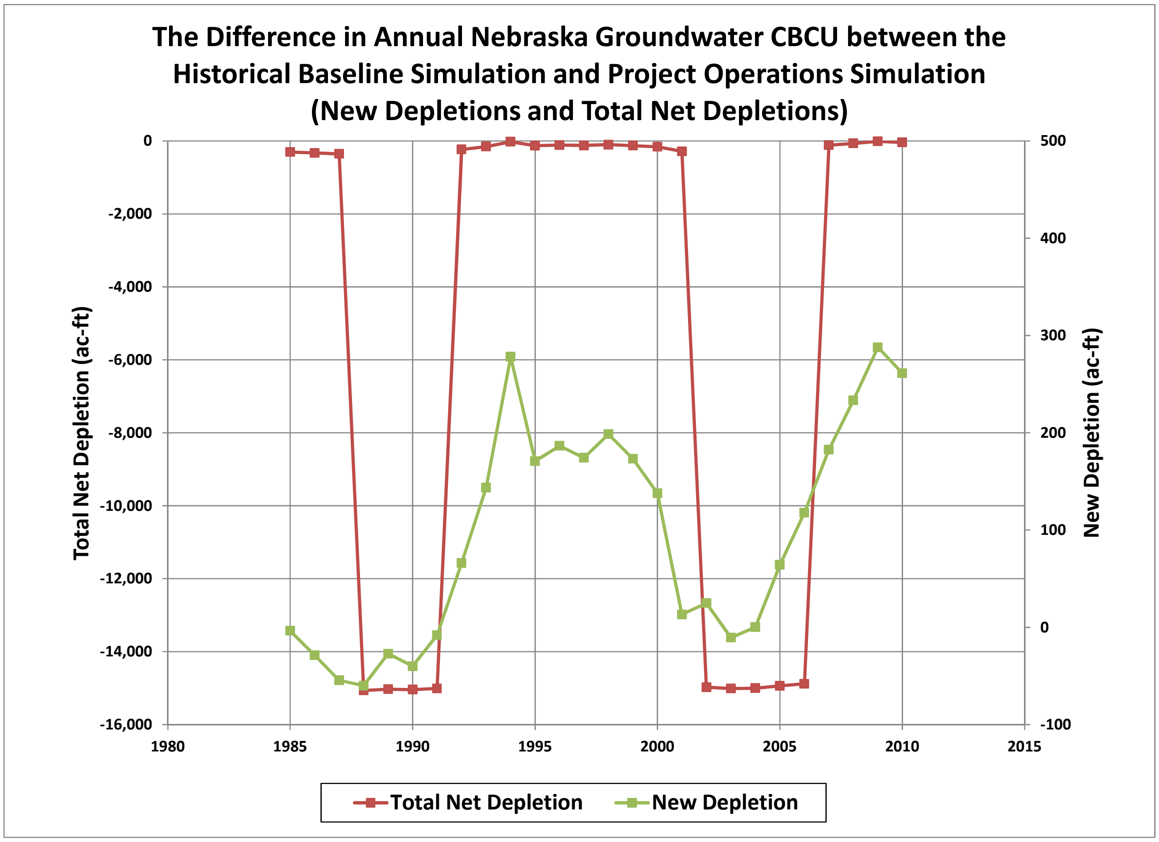


Figure 4. Simulated new depletion under projected future operations groundwater pumping, AWS credit, and the net depletions of project operation on the stream (negative net depletion values indicate no new net depletion).

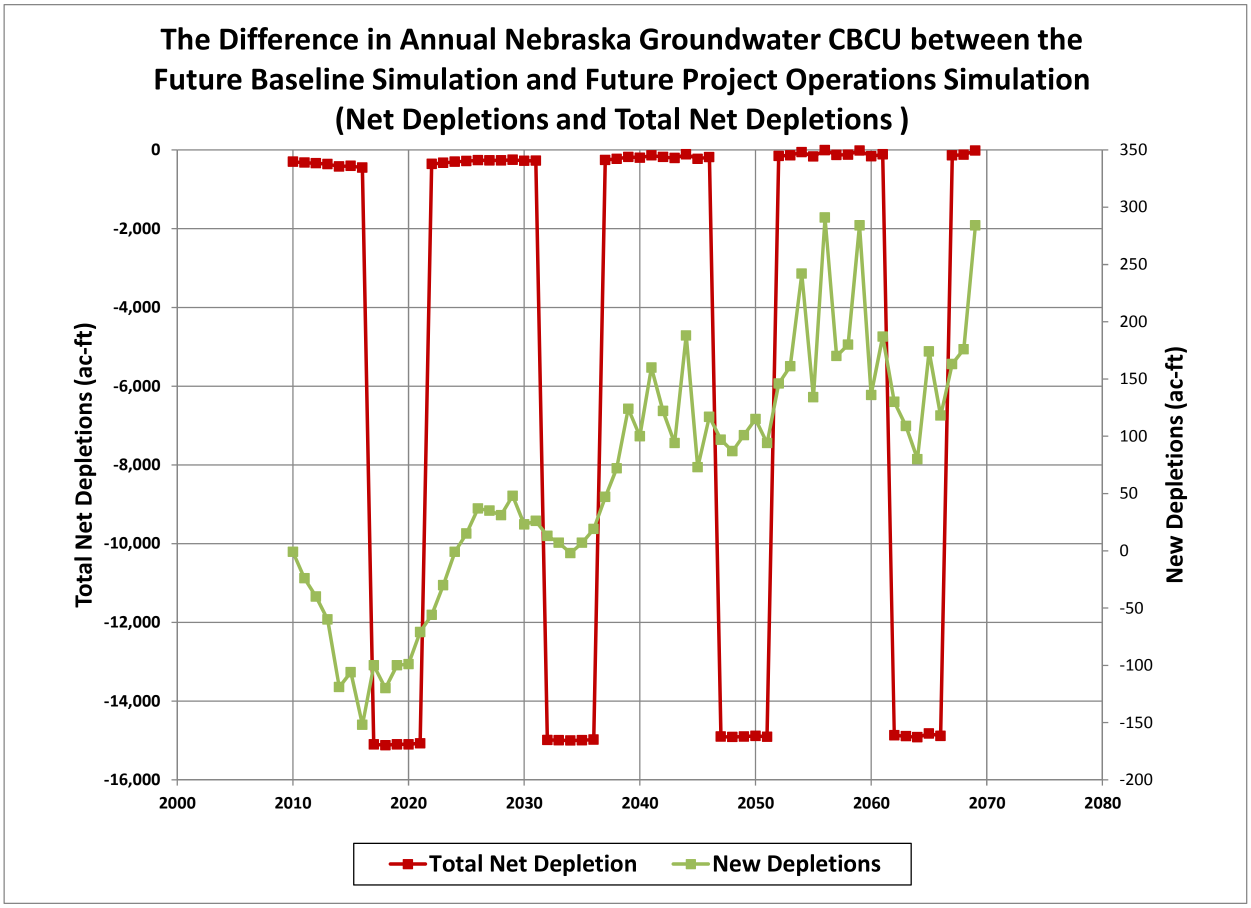


Figure 5. Simulated future net depletion of project operations groundwater pumping and augmentation vs. simulated baseline future groundwater pumping (negative values indicate no new net depletion).

Appendix A

Republican River Compact Administration

ACCOUNTING PROCEDURES

AND

REPORTING REQUIREMENTS

Revised August 12, 2010

Comment [A1]: Update to new date

Table of Contents

Comment [A2]: Update table of contents

I. Introduction

This document describes the definitions, procedures, basic formulas, specific formulas, and data requirements and reporting formats to be used by the RRCA to compute the Virgin Water Supply, Computed Water Supply, Allocations, Imported Water Supply Credit, Augmentation Water Supply Credit, and Computed Beneficial Consumptive Use. These computations shall be used to determine supply, allocations, use and compliance with the Compact according to the Stipulation. These definitions, procedures, basic and specific formulas, data requirements and attachments may be changed by consent of the RRCA consistent with Subsection I.F of the Stipulation. This document will be referred to as the RRCA Accounting Procedures. Attached to these RRCA Accounting Procedures as Figure 1 is the map attached to the Compact that shows the Basin, its streams and the Basin boundaries.

II. Definitions

The following words and phrases as used in these RRCA Accounting Procedures are defined as follows:

Additional Water Administration Year - a year when the projected or actual irrigation water supply is less than 130,000 Acre-feet of storage available for use from Harlan County Lake as determined by the Bureau of Reclamation using the methodology described in the Harlan County Lake Operation Consensus Plan attached as Appendix K to the Stipulation.

Allocation(s): the water supply allocated to each State from the Computed Water Supply;

Annual: yearly from January 1 through December 31;

Augmentation Plan: the detailed program used by a State to offset stream depletions in order to comply with its Compact Allocations. The Augmentation Plans shall be approved by the RRCA prior to implementation;

Augmentation Water Supply Credit: The amount of water measured and discharged under an approved Augmentation Plan to a Designated Drainage Basin for the purpose of offsetting stream depletions to comply with a States' Compact allocation. The Augmentation Water Supply Credit of a State shall not be included in the Virgin Water Supply in the aforementioned Designated Drainage Basin and shall be counted as a credit/offset against the Computed Beneficial Consumptive Use of water allocated to that State;

Basin: the Republican River Basin as defined in Article II of the Compact;

Beneficial Consumptive Use: that use by which the Water Supply of the Basin is consumed through the activities of man, and shall include water consumed by evaporation from any reservoir, canal, ditch, or irrigated area;

Change in Federal Reservoir Storage: the difference between the amount of water in storage in the reservoir on December 31 of each year and the amount of water in storage on December 31 of the previous year. The current area capacity table supplied by the appropriate federal operating agency shall be used to determine the contents of the reservoir on each date;

Compact: the Republican River Compact, Act of February 22, 1943, 1943 Kan. Sess. Laws 612, codified at Kan. Stat. Ann. § 82a-518 (1997); Act of February 24, 1943, 1943 Neb. Laws 377, codified at 2A Neb. Rev. Stat. App. § 1-106 (1995), Act of March 15, 1943, 1943 Colo. Sess. Laws 362, codified at Colo. Rev. Stat. §§ 37-67-101 and 37-67-102 (2001); Republican River Compact, Act of May 26, 1943, ch. 104, 57 Stat. 86;

Computed Beneficial Consumptive Use: for purposes of Compact accounting, the stream flow depletion resulting from the following activities of man:

Irrigation of lands in excess of two acres;
Any non-irrigation diversion of more than 50 Acre-feet per year;
Multiple diversions of 50 Acre-feet or less that are connected or otherwise combined to serve a single project will be considered as a single diversion for accounting purposes if they total more than 50 Acre-feet;
Net evaporation from Federal Reservoirs;
Net evaporation from Non-federal Reservoirs within the surface boundaries of the Basin;
Any other activities that may be included by amendment of these formulas by the RRCA;

Computed Water Supply: the Virgin Water Supply less the Change in Federal Reservoir Storage in any Designated Drainage Basin, and less the Flood Flows;

Designated Drainage Basins: the drainage basins of the specific tributaries and the Main Stem of the Republican River as described in Article III of the Compact. Attached hereto as Figure 3 is a map of the Sub-basins and Main Stem;

Dewatering Well: a Well constructed solely for the purpose of lowering the groundwater elevation;

Federal Reservoirs:

Bonny Reservoir
Swanson Lake
Enders Reservoir
Hugh Butler Lake
Harry Strunk Lake

Keith Sebelius Lake
Harlan County Lake
Lovewell Reservoir

Flood Flows: the amount of water deducted from the Virgin Water Supply as part of the computation of the Computed Water Supply due to a flood event as determined by the methodology described in Subsection III.B.1.;

Gaged Flow: the measured flow at the designated stream gage;

Guide Rock: a point at the Superior-Courtland Diversion Dam on the Republican River near Guide Rock, Nebraska; the Superior-Courtland Diversion Dam gage plus any flows through the sluice gates of the dam, specifically excluding any diversions to the Superior and Courtland Canals, shall be the measure of flows at Guide Rock;

Historic Consumptive Use: that amount of water that has been consumed under appropriate and reasonably efficient practices to accomplish without waste the purposes for which the appropriation or other legally permitted use was lawfully made;

Imported Water Supply: the water supply imported by a State from outside the Basin resulting from the activities of man;

Imported Water Supply Credit: the accretions to stream flow due to water imports from outside of the Basin as computed by the RRCA Groundwater Model. The Imported Water Supply Credit of a State shall not be included in the Virgin Water Supply and shall be counted as a credit/offset against the Computed Beneficial Consumptive Use of water allocated to that State, except as provided in Subsection V.B.2. of the Stipulation and Subsections III.I. – J. of these RRCA Accounting Procedures;

Main Stem: the Designated Drainage Basin identified in Article III of the Compact as the North Fork of the Republican River in Nebraska and the main stem of the Republican River between the junction of the North Fork and the Arikaree River and the lowest crossing of the river at the Nebraska-Kansas state line and the small tributaries thereof, and also including the drainage basin Blackwood Creek;

Main Stem Allocation: the portion of the Computed Water Supply derived from the Main Stem and the Unallocated Supply derived from the Sub-basins as shared by Kansas and Nebraska;

Meeting(s): a meeting of the RRCA, including any regularly scheduled annual meeting or any special meeting;

Modeling Committee: the modeling committee established in Subsection IV.C. of the Stipulation;

Moratorium: the prohibition and limitations on construction of new Wells in the geographic area described in Section III. of the Stipulation;

Non-federal Reservoirs: reservoirs other than Federal Reservoirs that have a storage capacity of 15 Acre-feet or greater at the principal spillway elevation;

Northwest Kansas: those portions of the Sub-basins within Kansas;

Replacement Well: a Well that replaces an existing Well that a) will not be used after construction of the new Well and b) will be abandoned within one year after such construction or is used in a manner that is excepted from the Moratorium pursuant to Subsections III.B.1.c.-f. of the Stipulation;

RRCA: Republican River Compact Administration, the administrative body composed of the State officials identified in Article IX of the Compact;

RRCA Accounting Procedures: this document and all attachments hereto;

RRCA Groundwater Model: the groundwater model developed under the provisions of Subsection IV.C. of the Stipulation and as subsequently adopted and revised through action of the RRCA;

State: any of the States of Colorado, Kansas, and Nebraska;

States: the States of Colorado, Kansas and Nebraska;

Stipulation: the Final Settlement Stipulation to be filed in *Kansas v. Nebraska and Colorado*, No. 126, Original, including all Appendices attached thereto;

Sub-basin: the Designated Drainage Basins, except for the Main Stem, identified in Article III of the Compact. For purposes of Compact accounting the following Sub-basins will be defined as described below:

> North Fork of the Republican River in Colorado drainage basin is that drainage area above USGS gaging station number 06823000, North Fork Republican River at the Colorado-Nebraska State Line,
>
> Arikaree River drainage basin is that drainage area above USGS gaging station number 06821500, Arikaree River at Haigler, Nebraska,
>
> Buffalo Creek drainage basin is that drainage area above USGS gaging station number 06823500, Buffalo Creek near Haigler, Nebraska,

Rock Creek drainage basin is that drainage area above USGS gaging station number 06824000, Rock Creek at Parks, Nebraska,

South Fork of the Republican River drainage basin is that drainage area above USGS gaging station number 06827500, South Fork Republican River near Benkelman, Nebraska,

Frenchman Creek (River) drainage basin in Nebraska is that drainage area above USGS gaging station number 06835500, Frenchman Creek in Culbertson, Nebraska,

Driftwood Creek drainage basin is that drainage area above USGS gaging station number 06836500, Driftwood Creek near McCook, Nebraska,

Red Willow Creek drainage basin is that drainage area above USGS gaging station number 06838000, Red Willow Creek near Red Willow, Nebraska,

Medicine Creek drainage basin is that drainage area above the Medicine Creek below Harry Strunk Lake, State of Nebraska gaging station number 06842500; and the drainage area between the gage and the confluence with the Main Stem,

Sappa Creek drainage basin is that drainage area above USGS gaging station number 06847500, Sappa Creek near Stamford, Nebraska and the drainage area between the gage and the confluence with the Main Stem; and excluding the Beaver Creek drainage basin area downstream from the State of Nebraska gaging station number 06847000 Beaver Creek near Beaver City, Nebraska to the confluence with Sappa Creek,

Beaver Creek drainage basin is that drainage area above State of Nebraska gaging station number 06847000, Beaver Creek near Beaver City, Nebraska, and the drainage area between the gage and the confluence with Sappa Creek,

Prairie Dog Creek drainage basin is that drainage area above USGS gaging station number 06848500, Prairie Dog Creek near Woodruff, Kansas, and the drainage area between the gage and the confluence with the Main Stem;

Attached hereto as Figure 2 is a line diagram depicting the streams, Federal Reservoirs and gaging stations;

Test hole: a hole designed solely for the purpose of obtaining information on hydrologic and/or geologic conditions;

Trenton Dam: a dam located at 40 degrees, 10 minutes, 10 seconds latitude and 101 degrees, 3 minutes, 35 seconds longitude, approximately two and one-half miles west of the town of Trenton, Nebraska;

Unallocated Supply: the "water supplies of upstream basins otherwise unallocated" as set forth in Article IV of the Compact;

Upstream of Guide Rock, Nebraska: those areas within the Basin lying west of a line proceeding north from the Nebraska-Kansas state line and following the western edge of Webster County, Township 1, Range 9, Sections 34, 27, 22, 15, 10 and 3 through Webster County, Township 2, Range 9, Sections 34, 27 and 22; then proceeding west along the southern edge of Webster County, Township 2, Range 9, Sections 16, 17 and 18; then proceeding north following the western edge of Webster County, Township 2, Range 9, Sections 18, 7 and 6, through Webster County, Township 3, Range 9, Sections 31, 30, 19, 18, 7 and 6 to its intersection with the northern boundary of Webster County. Upstream of Guide Rock, Nebraska shall not include that area in Kansas east of the 99° meridian and south of the Kansas-Nebraska state line;

Virgin Water Supply: the Water Supply within the Basin undepleted by the activities of man;

Water Short Year Administration: administration in a year when the projected or actual irrigation water supply is less than 119,000 acre feet of storage available for use from Harlan County Lake as determined by the Bureau of Reclamation using the methodology described in the Harlan County Lake Operation Consensus Plan attached as Appendix K to the Stipulation.

Water Supply of the Basin or **Water Supply within the Basin:** the stream flows within the Basin, excluding Imported Water Supply;

Well: any structure, device or excavation for the purpose or with the effect of obtaining groundwater for beneficial use from an aquifer, including wells, water wells, or groundwater wells as further defined and used in each State's laws, rules, and regulations.

III. Basic Formulas

The basic formulas for calculating Virgin Water Supply, Computed Water Supply, Imported Water Supply, Allocations and Computed Beneficial Consumptive Use are set forth below. The results of these calculations shall be shown in a table format as shown in Table 1.

Basic Formulas for Calculating Virgin Water Supply, Computed Water Supply, Allocations and Computed Beneficial Consumptive Use		
Sub-basin VWS	=	Gage + All CBCU +ΔS – IWS – AWS
Main Stem VWS	=	Hardy Gage – Σ Sub-basin gages + All CBCU in the Main Stem +ΔS – IWS
CWS	=	VWS - Δ S – FF

Allocation for each State in each Sub-basin And Main Stem	=	CWS x %
State's Allocation	=	Σ Allocations for Each State
State's CBCU	=	Σ State's CBCUs in each Sub-basin and Main Stem

Abbreviations:

CBCU = Computed Beneficial Consumptive Use
FF = Flood Flows
Gage = Gaged Flow
IWS = Imported Water Supply Credit
AWS = Augmentation Water Supply Credit
CWS = Computed Water Supply
VWS = Virgin Water Supply
% = the ratio used to allocate the Computed Water Supply between the States. This ratio is based on the allocations in the Compact
Δ S = Change in Federal Reservoir Storage

A. Calculation of Annual Virgin Water Supply

1. Sub-basin calculation:

The annual Virgin Water Supply for each Sub-basin will be calculated by adding: a) the annual stream flow in that Sub-basin at the Sub-basin stream gage designated in Section II., b) the annual Computed Beneficial Consumptive Use above that gaging station, and c) the Change in Federal Reservoir Storage in that Sub-basin; and from that total subtract any Imported Water Supply Credit and any Augmentation Water Supply Credit. The Computed Beneficial Consumptive Use will be calculated as described in Subsection III. D. Adjustments for flows diverted around stream gages and for Computed Beneficial Consumptive Uses in the Sub-basin between the Sub-basin stream gage and the confluence of the Sub-basin tributary and the Main Stem shall be made as described in Subsections III. D. 1 and 2 and IV. B.

2. Main Stem Calculation:

The annual Virgin Water Supply for the Main Stem will be calculated by adding: a) the flow at the Hardy gage minus the flows from the Sub-basin gages listed in Section II, b) the annual Computed Beneficial Consumptive Use in the Main Stem, and c) the Change in Federal Reservoir Storage from Swanson Lake and Harlan

County Lake; and from that total subtract any Imported Water Supply Credit for the Main Stem. Adjustments for flows diverted around Sub-basin stream gages and for Computed Beneficial Consumptive Uses in a Sub-basin between the Sub-basin stream gage and the confluence of the Sub-basin tributary and the Mains Stem shall be made as described in Subsections III. D. 1 and 2 and IV.B.,

3. Imported Water Supply Credit Calculation:

The amount of Imported Water Supply Credit shall be determined by the RRCA Groundwater Model. The Imported Water Supply Credit of a State shall not be included in the Virgin Water Supply and shall be counted as a credit/offset against the Computed Beneficial Consumptive Use of water allocated to that State. Currently, the Imported Water Supply Credits shall be determined using two runs of the RRCA Groundwater Model:

a. The "base" run shall be the run with all groundwater pumping, groundwater pumping recharge, and surface water recharge within the model study boundary for the current accounting year turned "on." This will be the same "base" run used to determine groundwater Computed Beneficial Consumptive Uses.

b. The "no NE import" run shall be the run with the same model inputs as the base run with the exception that surface water recharge associated with Nebraska's Imported Water Supply shall be turned "off."

The Imported Water Supply Credit shall be the difference in stream flows between these two model runs. Differences in stream flows shall be determined at the same locations as identified in Subsection III.D.1.for the "no pumping" runs. Should another State import water into the Basin in the future, the RRCA will develop a similar procedure to determine Imported Water Supply Credits.

4. Augmentation Water Supply Credit: The amount of water measured and discharged under an approved Augmentation Plan to a Designated Drainage Basin for the purpose of offsetting stream depletions to comply with a States' Compact allocation.

B. Calculation of Computed Water Supply

On any Designated Drainage Basin without a Federal Reservoir, the Computed Water Supply will be equal to the Virgin Water Supply of that Designated Drainage Basin minus Flood Flows.

On any Designated Drainage Basin with a Federal Reservoir, the Computed Water Supply will be equal to the Virgin Water Supply minus the Change in Federal Reservoir Storage in that Designated Drainage Basin and minus Flood Flows.

1. Flood Flows

If in any calendar year there are five consecutive months in which the total actual stream flow[1] at the Hardy gage is greater than 325,000 Acre-feet, or any two consecutive months in which the total actual stream flow is greater than 200,000 Acre-feet, the annual flow in excess of 400,000 Acre-feet at the Hardy gage will be considered to be Flood Flows that will be subtracted from the Virgin Water Supply to calculate the Computed Water Supply, and Allocations. The Flood Flow in excess of 400,000 Acre-feet at the Hardy gage will be subtracted from the Virgin Water Supply of the Main Stem to compute the Computed Water Supply unless the Annual Gaged Flows from a Sub-basin were in excess of the flows shown for that Sub-basin in Attachment 1. These excess Sub-basin flows shall be considered to be Sub-basin Flood Flows.

If there are Sub-basin Flood Flows, the total of all Sub-basin Flood Flows shall be compared to the amount of Flood Flows at the Hardy gage. If the sum of the Sub-basin Flood Flows are in excess of the Flood Flow at the Hardy gage, the flows to be deducted from each Sub-basin shall be the product of the Flood Flows for each Sub-basin times the ratio of the Flood Flows at the Hardy gage divided by the sum of the Flood Flows of the Sub-basin gages. If the sum of the Sub-basin Flood Flows is less than the Flood Flow at the Hardy gage, the entire amount of each Sub-basin Flood Flow shall be deducted from the Virgin Water Supply to compute the Computed Water Supply of that Sub-basin for that year. The remainder of the Flood Flows will be subtracted from the flows of the Main Stem.

C. Calculation of Annual Allocations

Article IV of the Compact allocates 54,100 Acre-feet for Beneficial Consumptive Use in Colorado, 190,300 Acre-feet for Beneficial Consumptive Use in Kansas and 234,500 Acre-feet for Beneficial Consumptive Use in Nebraska. The Compact provides that the Compact totals are to be derived from the sources and in the amounts specified in Table 2.

The Allocations derived from each Sub-basin to each State shall be the Computed Water Supply multiplied by the percentages set forth in Table 2. In addition, Kansas shall receive 51.1% of the Main Stem Allocation and the Unallocated

[1] These actual stream flows reflect Gaged Flows after depletions by Beneficial Consumptive Use and change in reservoir storage above the gage.

Supply and Nebraska shall receive 48.9% of the Main Stem Allocation and the Unallocated Supply.

D. Calculation of Annual Computed Beneficial Consumptive Use

1. Groundwater

Computed Beneficial Consumptive Use of groundwater shall be determined by use of the RRCA Groundwater Model. The Computed Beneficial Consumptive Use of groundwater for each State shall be determined as the difference in streamflows using two runs of the model:

The “base” run shall be the run with all groundwater pumping, groundwater pumping recharge, and surface water recharge within the model study boundary for the current accounting year “on”.

The “no State pumping” run shall be the run with the same model inputs as the base run with the exception that all groundwater pumping and pumping recharge of that State shall be turned “off.”

An output of the model is baseflows at selected stream cells. Changes in the baseflows predicted by the model between the “base” run and the “no-State-pumping” model run is assumed to be the depletions to streamflows. i.e., groundwater computed beneficial consumptive use, due to State groundwater pumping at that location. The values for each Sub-basin will include all depletions and accretions upstream of the confluence with the Main Stem. The values for the Main Stem will include all depletions and accretions in stream reaches not otherwise accounted for in a Sub-basin. The values for the Main Stem will be computed separately for the reach above Guide Rock, and the reach below Guide Rock.

2. Surface Water

The Computed Beneficial Consumptive Use of surface water for irrigation and non-irrigation uses shall be computed by taking the diversions from the river and subtracting the return flows to the river resulting from those diversions, as described in Subsections IV.A.2.a.-d. The Computed Beneficial Consumptive Use of surface water from Federal Reservoir and Non-Federal Reservoir evaporation shall be the net reservoir evaporation from the reservoirs, as described in Subsections IV.A.2.e.-f.

For Sub-basins where the gage designated in Section II. is near the confluence with the Main Stem, each State's Sub-basin Computed Beneficial Consumptive Use of surface water shall be the State's Computed Beneficial Consumptive Use of surface water above the Sub-basin gage. For Medicine Creek, Sappa Creek, Beaver Creek and Prairie Dog Creek, where the gage is not near the confluence with the Main Stem, each State's Computed Beneficial Consumptive Use of surface water shall be the sum of the State's Computed Beneficial Consumptive Use of surface water above the gage, and its Computed Beneficial Consumptive Use of surface water between the gage and the confluence with the Main Stem.

E. Calculation to Determine Compact Compliance Using Five-Year Running Averages

Each year, using the procedures described herein, the RRCA will calculate the Annual Allocations by Designated Drainage Basin and total for each State, the Computed Beneficial Consumptive Use by Designated Drainage Basin and total for each State and the Imported Water Supply Credit and the Augmentation Water Supply Credit that a State may use for the preceding year. These results for the current Compact accounting year as well as the results of the previous four accounting years and the five-year average of these results will be displayed in the format shown in Table 3.

F. Calculations To Determine Colorado's and Kansas's Compliance with the Sub-basin Non-Impairment Requirement

The data needed to determine Colorado's and Kansas's compliance with the Sub-basin non-impairment requirement in Subsection IV.B.2. of the Stipulation are shown in Tables 4.A. and B.

G. Calculations To Determine Projected Water Supply

1. Procedures to Determine Water Short Years

The Bureau of Reclamation will provide each of the States with a monthly or, if requested by any one of the States, a more frequent update of the projected or actual irrigation supply from Harlan County Lake for that irrigation season using the methodology described in the Harlan County Lake Operation Consensus Plan, attached as Appendix K to the Stipulation. The steps for the calculation are as follows:

Step 1. At the beginning of the calculation month (1) the total projected inflow for the calculation month and each succeeding month through the end of May shall be added to the previous end of month Harlan County Lake content and (2) the total projected 1993 level evaporation loss for the calculation month and each succeeding month through the end of May shall then be subtracted. The total projected inflow shall be the 1993 level average monthly inflow or the running average monthly inflow for the previous five years, whichever is less.

Step 2. Determine the maximum irrigation water available by subtracting the sediment pool storage (currently 164,111 Acre-feet) and adding the summer sediment pool evaporation (20,000 Acre-feet) to the result from Step 1.

Step 3. For October through January calculations, take the result from Step 2 and using the Shared Shortage Adjustment Table in Attachment 2 hereto, determine the preliminary irrigation water available for release. The calculation using the end of December content (January calculation month) indicates the minimum amount of irrigation water available for release at the end of May. For February through June calculations, subtract the maximum irrigation water available for the January calculation month from the maximum irrigation water available for the calculation month. If the result is negative, the irrigation water available for release (January calculation month) stays the same. If the result is positive the preliminary irrigation water available for release (January calculation month) is increased by the positive amount.

Step 4. Compare the result from Step 3 to 119,000 Acre-feet. If the result from Step 3 is less than 119,000 Acre-feet Water Short Year Administration is in effect.

Step 5. The final annual Water-Short Year Administration calculation determines the total estimated irrigation supply at the end of June (calculated in July). Use the result from Step 3 for the end of May irrigation release estimate, add the June computed inflow to Harlan County Lake and subtract the June computed gross evaporation loss from Harlan County Lake.

2. Procedures to Determine 130,000 Acre Feet Projected Water Supply

To determine the preliminary irrigation supply for the October through June calculation months, follow the procedure described in steps 1 through 4 of the “Procedures to determine Water Short Years” Subsection III. G. 1. The result from step 4 provides the forecasted water supply, which is compared to 130,000 Acre-feet. For the July through September calculation months, use the previous end of calculation month preliminary irrigation supply, add the previous month’s Harlan County Lake computed inflow and subtract the previous month’s computed gross evaporation loss from Harlan County Lake to determine the current preliminary irrigation supply. The result is compared to 130,000 Acre-feet.

H. Calculation of Computed Water Supply, Allocations and Computed Beneficial Consumptive Use Above and Below Guide Rock During Water-Short Administration Years.

For Water-Short-Administration Years, in addition to the normal calculations, the Computed Water Supply, Allocations, Computed Beneficial Consumptive Use and Imported Water Supply Credits, and Augmentation Water Supply Credits shall also be calculated above Guide Rock as shown in Table 5C. These calculations shall be done in the same manner as in non-Water-Short Administration years except that water supplies originating below Guide Rock shall not be included in the calculations of water supplies originating above Guide Rock. The calculations of Computed Beneficial Consumptive Uses shall be also done in the same manner as in non-Water-Short Administration years except that Computed Beneficial Consumptive Uses from diversions below Guide Rock shall not be included. The depletions from the water diverted by the Superior and Courtland Canals at the Superior-Courtland Diversion Dam shall be included in the calculations of Computed Beneficial Consumptive Use above Guide Rock. Imported Water Supply Credits and Augmentation Water Supply Credits above Guide Rock, as described in Sub-section III.I., may be used as offsets against the Computed Beneficial Consumptive Use above Guide Rock by the State providing the Imported Water Supply Credits or Augmentation Water Supply Credits.

The Computed Water Supply of the Main Stem reach between Guide Rock and the Hardy gage shall be determined by taking the difference in stream flow at Hardy and Guide Rock, adding Computed Beneficial Consumptive Uses in the reach (this does not include the Computed Beneficial Consumptive Use from the Superior and Courtland Canal diversions), and subtracting return flows from the Superior and Courtland Canals in the reach. The Computed Water Supply above Guide Rock shall be determined by subtracting the Computed Water Supply of the Main Stem reach between Guide Rock and the Hardy gage from the total Computed Water Supply. Nebraska's Allocation above Guide Rock shall be determined by subtracting 48.9% of the Computed Water Supply of the Main Stem reach between Guide Rock and the Hardy gage from Nebraska's total Allocation. Nebraska's Computed Beneficial Consumptive Uses above Guide Rock shall be determined by subtracting Nebraska's Computed Beneficial Consumptive Uses below Guide Rock from Nebraska's total Computed Beneficial Consumptive Use.

I. Calculation of Imported Water Supply Credits During Water-Short Year Administration Years.

Imported Water Supply Credit during Water-Short Year Administration years shall be calculated consistent with Subsection V.B.2.b. of the Stipulation.

The following methodology shall be used to determine the extent to which Imported Water Supply Credit, as calculated by the RRCA Groundwater Model, can be credited to the State importing the water during Water-Short Year Administration years.

1. Monthly Imported Water Supply Credits

The RRCA Groundwater Model will be used to determine monthly Imported Water Supply Credits by State in each Sub-basin and for the Main Stem. The values for each Sub-basin will include all depletions and accretions upstream of the confluence with the Main Stem. The values for the Main Stem will include all depletions and accretions in stream reaches not otherwise accounted for in a Sub-basin. The values for the Main Stem will be computed separately for the reach 1) above Harlan County Dam, 2) between Harlan County Dam and Guide Rock, and 3) between Guide Rock and the Hardy gage. The Imported Water Supply Credit shall be the difference in stream flow for two runs of the model: a) the "base" run and b) the "no State import" run.

During Water-Short Year Administration years, Nebraska's credits in the Sub-basins shall be determined as described in Section III. A. 3.

2. Imported Water Supply Credits Above Harlan County Dam

Nebraska's Imported Water Supply Credits above Harlan County Dam shall be the sum of all the credits in the Sub-basins and the Main Stem above Harlan County Dam.

3. Imported Water Supply Credits Between Harlan County Dam and Guide Rock During the Irrigation Season

a. During Water-Short Year Administration years, monthly credits in the reach between Harlan County Dam and Guide Rock shall be determined as the differences in the stream flows between the two runs at Guide Rock.

b. The irrigation season shall be defined as starting on the first day of release of water from Harlan County Lake for irrigation use and ending on the last day of release of water from Harlan County Lake for irrigation use.

c. Credit as an offset for a State's Computed Beneficial Consumptive Use above Guide Rock will be given to all the Imported Water Supply accruing in the reach between Harlan County Dam and Guide Rock during the irrigation season. If the period of the irrigation season does not coincide with the period of modeled flows, the amount of the Imported Water Supply credited during the irrigation season for that month shall be the total monthly modeled Imported Water Supply Credit times the number of days in the month occurring during the irrigation season divided by the total number of days in the month.

4. Imported Water Supply Credits Between Harlan County Dam and Guide Rock During the Non-Irrigation Season

a. Imported Water Supply Credit shall be given between Harlan County Dam and Guide Rock during the period that flows are diverted to fill Lovewell Reservoir to the extent that imported water was needed to meet Lovewell Reservoir target elevations.

b. Fall and spring fill periods shall be established during which credit shall be given for the Imported Water Supply Credit accruing in the reach. The fall period shall extend from the end of the irrigation season to December 1. The spring period shall extend from March 1 to May 31. The Lovewell target elevations for these fill periods are the projected end of November reservoir level and the projected end of May reservoir level for most probable inflow conditions as indicated in Table 4 in the current Annual Operating Plan prepared by the Bureau of Reclamation.

c. The amount of water needed to fill Lovewell Reservoir for each period shall be calculated as the storage content of the reservoir at its target elevation at the end of the fill period minus the reservoir content at the start of the fill period plus the amount of net evaporation during this period minus White Rock Creek inflows for the same period.

d. If the fill period as defined above does not coincide with the period of modeled flows, the amount of the Imported Water Supply Credit during the fill period for that month shall be the total monthly modeled Imported Water Supply Credit times the number of days in the month occurring during the fill season divided by the total number of days in the month.

e. The amount of non-imported water available to fill Lovewell Reservoir to the target elevation shall be the amount of water available at Guide Rock during the fill period minus the amount of the Imported Water Supply Credit accruing in the reach during the same period.

f. The amount of the Imported Water Supply Credit that shall be credited against a State's Consumptive Use shall be the amount of water imported by that State that is available in the reach during the fill period or the amount of water needed to reach Lovewell Reservoir target elevations minus the amount of non-imported water available during the fill period, whichever is less.

5. Other Credits

Kansas and Nebraska will explore crediting Imported Water Supply that is otherwise useable by Kansas.

J. Calculations of Compact Compliance in Water-Short Year Administration Years

During Water-Short Year Administration, using the procedures described in Subsections III.A-D, the RRCA will calculate the Annual Allocations for each State, the Computed Beneficial Consumptive Use by each State, the ~~and~~ Imported Water Supply Credit, and the Augmentation Water Supply Credit that a State may use to offset Computed Beneficial Consumptive Use in that year. The resulting annual and average values will be calculated as displayed in Tables 5 A-C and E.

If Nebraska is implementing an Alternative Water-Short-Year Administration Plan, data to determine Compact compliance will be shown in Table 5D. Nebraska's compliance with the Compact will be determined in the same manner as Nebraska's Above Guide Rock compliance except that compliance will be based on a three-year running average of the current year and previous two year calculations. In addition, Table 5 D. will display the sum of the previous two-year difference in Allocations above Guide Rock and Computed Beneficial Consumptive Uses above Guide Rock minus any Imported Water Credits and compare the result with the Alternative Water-Short-Year Administration Plan's expected decrease in Computed Beneficial Consumptive Use above Guide Rock. Nebraska will be within compliance with the Compact as long as the three-year running average difference in Column 8 is positive and the sum of the previous year and current year deficits above Guide Rock are not greater than the expected decrease in Computed Beneficial Consumptive Use under the plan.

IV. Specific Formulas

A. Computed Beneficial Consumptive Use

1. Computed Beneficial Consumptive Use of Groundwater:

The Computed Beneficial Consumptive Use caused by groundwater diversion shall be determined by the RRCA Groundwater Model as described in Subsection III.D.1.

2. Computed Beneficial Consumptive Use of Surface Water:

The Computed Beneficial Consumptive Use of surface water shall be calculated as follows:

a) Non-Federal Canals

Computed Beneficial Consumptive Use from diversions by non- federal canals shall be 60 percent of the diversion; the return flow shall be 40 percent of the diversion

b) Individual Surface Water Pumps

Computed Beneficial Consumptive Use from small individual surface water pumps shall be 75 percent of the diversion; return flows will be 25 percent of the diversion unless a state provides data on the amount of different system types in a Sub-basin, in which case the following percentages will be used for each system type:

Gravity Flow.	30%
Center Pivot	17%
LEPA	10%

c) Federal Canals

Computed Beneficial Consumptive Use of diversions by Federal canals will be calculated as shown in Attachment 7. For each Bureau of Reclamation Canal the field deliveries shall be subtracted from the diversion from the river to determine the canal losses. The field delivery shall be multiplied by one minus an average system efficiency for the district to determine the loss of water from the field. Eighty-two percent of the sum of the field loss plus the canal loss shall be considered to be the return flow from the canal diversion. The assumed field efficiencies and the amount of the field and canal loss that reaches the stream may be reviewed by the RRCA and adjusted as appropriate to insure their accuracy.

d) Non-irrigation Uses

Any non-irrigation uses diverting or pumping more than 50 acre-feet per year will be required to measure diversions. Non-irrigation uses diverting more than 50 Acre-feet per year will be assessed a Computed Beneficial Consumptive Use of 50% of what is pumped or diverted, unless the entity presents evidence to the RRCA demonstrating a different percentage should be used.

e) Evaporation from Federal Reservoirs

Net Evaporation from Federal Reservoirs will be calculated as follows:

(1) Harlan County Lake, Evaporation Calculation

April 1 through October 31:

Evaporation from Harlan County Lake is calculated by the Corps of Engineers on a daily basis from April 1 through October 31. Daily readings are taken from a Class A evaporation pan maintained near the project office. Any precipitation recorded at the project office is added to the pan reading to obtain the actual evaporation amount. The pan value is multiplied by a pan coefficient that varies by month. These values are:

March	.56
April	.52
May	.53
June	.60
July	.68
August	.78
September	.91
October	1.01

The pan coefficients were determined by studies the Corps of Engineers conducted a number of years ago. The result is the evaporation in inches. It is divided by 12 and multiplied by the daily lake surface area in acres to obtain the evaporation in Acre-feet. The lake surface area is determined by the 8:00 a.m. elevation reading applied to the lake's area-capacity data. The area-capacity data is updated periodically through a sediment survey. The last survey was completed in December 2000.

November 1 through March 31

During the winter season, a monthly total evaporation in inches has been determined. The amount varies with the percent of ice cover. The values used are:

HARLAN COUNTY LAKE

Estimated Evaporation in Inches
Winter Season -- Monthly Total

PERCENTAGE OF ICE COVER

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
JAN	0.88	0.87	0.85	0.84	0.83	0.82	0.81	0.80	0.78	0.77	0.76
FEB	0.90	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.80	0.79
MAR	1.29	1.28	1.27	1.26	1.25	1.24	1.23	1.22	1.21	1.20	1.19
OCT	4.87			NO ICE							
NOV	2.81			NO ICE							
DEC	1.31	1.29	1.27	1.25	1.24	1.22	1.20	1.18	1.17	1.16	1.14

The monthly total is divided by the number of days in the month to obtain a daily evaporation value in inches. It is divided by 12 and multiplied by the daily lake surface area in acres to obtain the evaporation in Acre-feet. The lake surface area is determined by the 8:00 a.m. elevation reading applied to the lake's area-capacity data. The area-capacity data is updated periodically through a sediment survey. The last survey was completed in December 2000.

To obtain the net evaporation, the monthly precipitation on the lake is subtracted from the monthly gross evaporation. The monthly precipitation is calculated by multiplying the sum of the month's daily precipitation in inches by the average of the end of the month lake surface area for the previous month and the end of the month lake surface area for the current month in acres and dividing the result by 12 to obtain the precipitation for the month in acre feet.

The total annual net evaporation (Acre-feet) will be charged to Kansas and Nebraska in proportion to the annual diversions made by the Kansas Bostwick Irrigation District and the Nebraska Bostwick Irrigation District during the time period each year when irrigation releases are being made from Harlan County Lake. For any year in which no irrigation releases were made from Harlan County Lake, the annual net evaporation charged to Kansas and Nebraska will be based on the average of the above calculation for the most recent three years in which irrigation releases from Harlan County Lake were made. In the event Nebraska chooses to substitute supply for the Superior Canal from Nebraska's allocation below Guide Rock in Water-Short Year Administration years, the amount of the substitute supply will be included in the calculation of the split as if it had been diverted to the Superior Canal at Guide Rock.

(2) Evaporation Computations for Bureau of Reclamation Reservoirs

The Bureau of Reclamation computes the amount of evaporation loss on a monthly basis at Reclamation reservoirs. The following procedure is utilized in calculating the loss in Acre-feet.

An evaporation pan reading is taken each day at the dam site. This measurement is the amount of water lost from the pan over a 24-hour period in inches. The evaporation pan reading is adjusted for any precipitation recorded during the 24-hour period. Instructions for determining the daily pan evaporation are found in the "National Weather Service Observing Handbook No. 2 – Substation Observations." All dams located in the Kansas River Basin with the exception of Bonny Dam are National Weather Service Cooperative Observers. The daily evaporation pan readings are totaled at the end of each month and converted to a "free water surface" (FWS) evaporation, also referred to as "lake" evaporation. The FWS evaporation is determined by multiplying the observed pan evaporation by a coefficient of .70 at each of the reservoirs. This coefficient can be affected by several factors including water and air temperatures. The National Oceanic and Atmospheric Administration (NOAA) has published technical reports describing the determination of pan coefficients. The coefficient used is taken from the "NOAA Technical Report NWS 33, Map of coefficients to convert class A pan evaporation to free water surface evaporation". This coefficient is used for the months of April through October when evaporation pan readings are recorded at the dams. The monthly FWS evaporation is then multiplied by the average surface area of the reservoir during the month in acres. Dividing this value by twelve will result in the amount of water lost to evaporation in Acre-feet during the month.

During the winter months when the evaporation pan readings are not taken, monthly evaporation tables based on the percent of ice cover are used. The tables used were developed by the Corps of Engineers and were based on historical average evaporation rates. A separate table was developed for each of the reservoirs. The monthly evaporation rates are multiplied by the .70 coefficient for pan to free water surface adjustment, divided by twelve to convert inches to feet and multiplied by the average reservoir surface area during the month in acres to obtain the total monthly evaporation loss in Acre-feet.

To obtain the net evaporation, the monthly precipitation on the lake is subtracted from the monthly gross evaporation. The monthly precipitation is calculated by multiplying the sum of the month's daily precipitation in inches by the average of the end of the month lake surface area for the previous month and the end of the month lake surface area for the current month in acres and dividing the result by 12 to obtain the precipitation for the month in acre feet.

f) Non-Federal Reservoir Evaporation:

For Non-Federal Reservoirs with a storage capacity less than 200 Acre-feet, the presumptive average annual surface area is 25% of the area at the principal spillway elevation. Net evaporation for each such Non-Federal Reservoir will be calculated by multiplying the presumptive average annual surface area by the net evaporation from the nearest climate and evaporation station to the Non-Federal Reservoir. A State may provide actual data in lieu of the presumptive criteria.

Net evaporation from Non-Federal Reservoirs with 200 Acre-feet of storage or greater will be calculated by multiplying the average annual surface area (obtained from the area-capacity survey) and the net evaporation from the nearest evaporation and climate station to the reservoir. If the average annual surface area is not available, the Non-Federal Reservoirs with 200 Acre-feet of storage or greater will be presumed to be full at the principal spillway elevation.

B. Specific Formulas for Each Sub-basin and the Main Stem

All calculations shall be based on the calendar year and shall be rounded to the nearest 10 Acre-feet using the conventional rounding formula of rounding up for all numbers equal to five or higher and otherwise rounding down.

Abbreviations:

AWS	= Augmentation Water Supply Credit
CBCU	= Computed Beneficial Consumptive Use
CWS	= Computed Water Supply
D	= Non-Federal Canal Diversions for Irrigation
Ev	= Evaporation from Federal Reservoirs
EvNFR	= Evaporation from Non-Federal Reservoirs
FF	= Flood Flow
GW	= Groundwater Computed Beneficial Consumptive Use (includes irrigation and non-irrigation uses)
IWS	= Imported Water Supply Credit from Nebraska
M&I	= Non-Irrigation Surface Water Diversions (Municipal and Industrial)
P	= Small Individual Surface Water Pump Diversions for Irrigation
RF	= Return Flow
VWS	= Virgin Water Supply
c	= Colorado
k	= Kansas
n	= Nebraska
ΔS	= Change in Federal Reservoir Storage
%	= Average system efficiency for individual pumps in the Sub-basin
% BRF	= Percent of Diversion from Bureau Canals that returns to the stream
###	= Value expected to be zero

3. North Fork of Republican River in Colorado [2]

CBCU Colorado	= 0.6 x Haigler Canal Diversion Colorado + 0.6 x Dc + % x Pc + 0.5 x M&Ic + EvNFRc + GWc
CBCU Kansas	= GWk
CBCU Nebraska	= 0.6 x Haigler Canal Diversion Nebraska + GWn
	Note: The diversion for Haigler Canal is split between Colorado and Nebraska based on the percentage of land irrigated in each state
VWS	= North Fork of the Republican River at the State Line, Stn.

[2] The RRCA will investigate whether return flows from the Haigler Canal diversion in Colorado may return to the Arikaree River, not the North Fork of the Republican River, as indicated in the formulas. If there are return flows from the Haigler Canal to the Arikaree River, these formulas will be changed to recognize those returns.

No. 06823000 + CBCUc + CBCUk + CBCUn + Nebraska Haigler Canal RF– IWS

Note: The Nebraska Haigler Canal RF returns to the Main Stem

CWS = VWS - FF

Allocation Colorado = 0.224 x CWS

Allocation Nebraska = 0.246 x CWS

Unallocated = 0.53 x CWS

4. Arikaree River $_2$

CBCU Colorado = 0.6 x Dc + % x Pc + 0.5 x M&Ic + EvNFRc + GWc

CBCU Kansas = 0.6 x Dk + % x Pk + 0.5 x M&Ik + EvNFRk + GWk

CBCU Nebraska = 0.6 x Dn + % x Pn + 0.5 x M&In + EvNFRn + GWn

VWS = Arikaree Gage at Haigler Stn. No. 06821500 + CBCUc + CBCUk + CBCUn – IWS

CWS = VWS - FF

Allocation Colorado = 0.785 x CWS

Allocation Kansas = 0.051 x CWS

Allocation Nebraska = 0.168 x CWS

Unallocated =-0.004 x CWS

5. Buffalo Creek

CBCU Colorado = 0.6 x Dc + % x Pc + 0.5 x M&In + EvNFRc + GWc

CBCU Kansas = GWk

CBCU Nebraska = 0.6 x Dn + % x Pn + 0.5 x M&In + EvNFRn + GWn

VWS = Buffalo Creek near Haigler Gage Stn. No. 06823500 + CBCUc + CBCUk + CBCUn – IWS

CWS = VWS - FF

Allocation Nebraska = 0.330 x CWS

Unallocated = 0.670 x CWS

6. Rock Creek

CBCU Colorado = GWc

CBCU Kansas = GWk

CBCU Nebraska = 0.6 x Dn + % x Pn + 0.5 x M&In + EvNFRn + GWn

VWS = Rock Creek at Parks Gage Stn. No. 06824000 + CBCUc + CBCUk + CBCUn – IWS – AWS

CWS = VWS - FF

Allocation Nebraska = 0.400 x CWS

Unallocated = 0.600 x CWS

7. South Fork Republican River

CBCU Colorado = 0.6 x Hale Ditch Diversion + 0.6 x Dc + % x Pc + 0.5 x M&Ic + EvNFRc + Bonny Reservoir Ev + GWc

CBCU Kansas = 0.6 x Dk + % x Pk + 0.5 x M&Ik + EvNFRk + GWk

CBCU Nebraska = 0.6 x Dn + % x Pn + 0.5 x M&In + EvNFRn + GWn

VWS = South Fork Republican River near Benkelman Gage Stn. No. 06827500 + CBCUc + CBCUk + CBCUn + ΔS Bonny Reservoir – IWS

CWS = VWS - ΔS Bonny Reservoir - FF

Allocation Colorado = 0.444 x CWS

Allocation Kansas = 0.402 x CWS

Allocation Nebraska = 0.014 x CWS

Unallocated = 0.140 x CWS

8. Frenchman Creek in Nebraska

CBCU Colorado = GWc

CBCU Kansas = GWk

CBCU Nebraska = Culbertson Canal Diversions x (1-%BRF) + Culbertson Extension x (1-%BRF) + 0.6 x Champion Canal Diversion + 0.6 x Riverside Canal Diversion + 0.6 x Dn + % x Pn + 0.5 x M&In + EvNFRn + Enders Reservoir Ev + GWn

VWS = Frenchman Creek in Culbertson, Nebraska Gage Stn. No. 06835500 + CBCUc + CBCUk + CBCUn + 0.17 x Culbertson Diversion RF + Culbertson Extension RF + 0.78 x Riverside Diversion RF + ΔS Enders Reservoir – IWS

Note: 17% of the Culbertson Diversion RF and 100% of the Culbertson Extension RF return to the Main Stem

CWS = VWS - ΔS Enders Reservoir – FF

Allocation Nebraska = 0.536 x CWS

Unallocated = 0.464 x CWS

9. Driftwood Creek

CBCU Colorado = GWc

CBCU Kansas = 0.6 x Dk + % x Pk + 0.5 x M&Ik + EvNFRk + GWk

CBCU Nebraska = 0.6 x Dn + % x Pn + 0.5 x M&In + EvNFRn + GWn

VWS = Driftwood Creek near McCook Gage Stn. No. 06836500 + CBCUc + CBCUk + CBCUn – 0.24 x Meeker Driftwood Canal RF - IWS

Note: 24 % of the Meeker Driftwood Canal RF returns to Driftwood Creek

CWS = VWS – FF

Allocation Kansas = 0.069 x CWS

Allocation Nebraska = 0.164 x CWS

Unallocated = 0.767 x CWS

10. Red Willow Creek in Nebraska

CBCU Colorado = GWc

CBCU Kansas = GWk

CBCU Nebraska = 0.1 x Red Willow Canal CBCU + 0.6 x Dn + % x Pn + 0.5 x M&In + EvNFRn + 0.1 x Hugh Butler Lake Ev + GWn

Note:
Red Willow Canal CBCU = Red Willow Canal Diversion x (1- % BRF)

90% of the Red Willow Canal CBCU and 90% of Hugh Butler Lake Ev charged to Nebraska's CBCU in the Main Stem

VWS = Red Willow Creek near Red Willow Gage Stn. No. 06838000 + CBCUc + CBCUk + CBCUn + 0.9 x Red Willow Canal CBCU + 0.9 x Hugh Butler Lake Ev + 0.9 xRed Willow Canal RF + ΔS Hugh Butler Lake – IWS

Note: 90% of the Red Willow Canal RF returns to the Main Stem

CWS = VWS - ΔS Hugh Butler Lake - FF

Allocation Nebraska = 0.192 x CWS

Unallocated = 0.808 x CWS

11. Medicine Creek

CBCU Colorado = GWc

CBCU Kansas = GWk

CBCU Nebraska = 0.6 x Dn above and below gage + % x Pn above and below gage + 0.5 x M&In above and below gage + EvNFRn above and below gage + GWn

Note: Harry Strunk Lake Ev charged to Nebraska's CBCU in the Main Stem.

CU from Harry Strunk releases in the Cambridge Canal is charged to the Main stem (no adjustment to the VWS formula is needed as this water shows up in the Medicine Creek gage).

VWS = Medicine Creek below Harry Strunk Lake Gage Stn. No. 06842500 + CBCUc + CBCUk + CBCUn – 0.6 x Dn below gage - % x Pn below gage – 0.5 * M&In below gage - EvNFRn below gage + Harry Strunk Lake Ev + ΔS Harry Strunk Lake– IWS

Note: The CBCU surface water terms for Nebraska which occur below the gage are added in the VWS for the Main Stem

CWS = VWS - ΔS Harry Strunk Lake - FF

Allocation Nebraska = 0.091 x CWS

Unallocated = 0.909 x CWS

12. Beaver Creek

CBCU Colorado	= 0.6 x Dc + % x Pc + 0.5 x M&Ic + EvNFRc + GWc
CBCU Kansas	= 0.6 x Dk + % x Pk + 0.5 x M&Ik + EvNFRk + GWk
CBCU Nebraska	= 0.6 x Dn above and below gage + % x Pn above and below gage + 0.5 x M&In above and below gage + EvNFRn above and below gage + GWn
VWS	= Beaver Creek near Beaver City gage Stn. No. 06847000 + BCUc + CBCUk + CBCUn – 0.6 x Dn below gage - % x Pn below gage – 0.5 * M&In below gage - EvNFRn below gage – IWS Note: The CBCU surface water terms for Nebraska which occur below the gage are added in the VWS for the Main Stem
CWS	= VWS – FF
Allocation Colorado	= 0.200 x CWS
Allocation Kansas	= 0.388 x CWS
Allocation Nebraska	= 0.406 x CWS
Unallocated	= 0.006 x CWS

13. Sappa Creek

CBCU Colorado	= GWc
CBCU Kansas	= 0.6 x Dk + % x Pk + 0.5 x M&Ik + EvNFRk + GWk
CBCU Nebraska	= 0.6 x Dn above and below gage + % x Pn above and below gage + 0.5 x M&In above and below gage + EvNFRn above and below gage + GWn
VWS	= Sappa Creek near Stamford gage Stn. No. 06847500 – Beaver Creek near Beaver City gage Stn. No. 06847000 + CBCUc + CBCUk + CBCUn – 0.6 x Dn below gage - % x

Pn below gage – 0.5 * M&In below gage - EvNFRn below gage – IWS

Note: The CBCU surface water terms for Nebraska which occur below the gage are added in the VWS for the Main Stem

CWS	= VWS - FF
Allocation Kansas	= 0.411 x CWS
Allocation Nebraska	= 0.411 x CWS
Unallocated	= 0.178 x CWS

14. Prairie Dog Creek

CBCU Colorado	= GWc
CBCU Kansas	= Almena Canal Diversion x (1-%BRF) + 0.6 x Dk + % x Pk + 0.5 x M&Ik + EvNFRk + Keith Sebelius Lake Ev + GWk
CBCU Nebraska	= 0.6 x Dn below gage + % x Pn below gage + 0.5 x M&In below gage + EvNFRn + GWn below gage
VWS	= Prairie Dog Creek near Woodruff, Kansas USGS Stn. No. 06848500 + CBCUc + CBCUk + CBCUn - 0.6 x Dn below gage - % x Pn below gage - 0.5 x M&In below gage - EvNFRn below gage + ΔS Keith Sebelius Lake – IWS Note: The CBCU surface water terms for Nebraska which occur below the gage are added in the VWS for the Main Stem
CWS	= VWS- ΔS Keith Sebelius Lake - FF
Allocation Kansas	= 0.457 x CSW
Allocation Nebraska	= 0.076 x CWS
Unallocated	= 0.467 x CWS

15. The North Fork of the Republican River in Nebraska and the Main Stem of the Republican River between the junction of the North Fork and the Arikaree River and the Republican River near Hardy

CBCU Colorado = GWc

CBCU Kansas =
(Deliveries from the Courtland Canal to Kansas above Lovewell) x (1-%BRF)
+ Amount of transportation loss of Courtland Canal deliveries to Lovewell that does not return to the river, charged to Kansas
+ (Diversions of Republican River water from Lovewell Reservoir by the Courtland Canal below Lovewell) x (1-%BRF)
+ 0.6 x Dk
+ % x Pk
+ 0.5 x M&Ik
+ EvNFRk
+ Harlan County Lake Ev charged to Kansas
+ Lovewell Reservoir Ev charged to the Republican River
+ GWk

CBCU Nebraska =
Deliveries from Courtland Canal to Nebraska lands x (1-%BRF)
+ Superior Canal x (1- %BRF)
+ Franklin Pump Canal x (1- %BRF)
+ Franklin Canal x (1- %BRF)
+ Naponee Canal x (1- %BRF)
+ Cambridge Canal x (1- %BRF)
+ Bartley Canal x (1- %BRF)
+ Meeker-Driftwood Canal x (1- %BRF)
+ 0.9 x Red Willow Canal CBCU
+ 0.6 x Dn
+ % x Pn
+ 0.5 x M&In
+ EvNFRn
+ 0.9 x Hugh Butler Lake Ev
+ Harry Strunk Lake Ev
+ Swanson Lake Ev
+ Harlan County Lake Ev charged to Nebraska
+ GWn

Notes:
The allocation of transportation losses in the Courtland Canal above Lovewell between Kansas and Nebraska shall be done by the Bureau of Reclamation and reported in their "Courtland Canal Above Lovewell" spreadsheet. Deliveries and losses associated with deliveries to both Nebraska and Kansas above Lovewell shall be reflected in the Bureau's Monthly Water District reports. Losses associated with delivering water to Lovewell shall be separately computed.

Amount of transportation loss of the Courtland Canal deliveries to Lovewell that does not return to the river, charged to Kansas shall be 18% of the Bureau's estimate of losses associated with these deliveries.

Red Willow Canal CBCU = Red Willow Canal Diversion x (1- % BRF)

10% of the Red Willow Canal CBCU is charged to Nebraska's CBCU in Red Willow Creek sub-basin

10% of Hugh Butler Lake Ev is charged to Nebraska's CBCU in the Red Willow Creek sub-basin

None of the Harry Strunk Lake EV is charged to Nebraska's CBCU in the Medicine Creek sub-basin

VWS =

Republican River near Hardy Gage Stn. No. 06853500
- North Fork of the Republican River at the State Line, Stn. No. 06823000
- Arikaree Gage at Haigler Stn. No. 06821500
- Buffalo Creek near Haigler Gage Stn. No. 06823500
- Rock Creek at Parks Gage Stn. No. 06824000
-South Fork Republican River near Benkelman Gage Stn. No. 06827500
- Frenchman Creek in Culbertson Stn. No. 06835500
- Driftwood Creek near McCook Gage Stn. No. 06836500
- Red Willow Creek near Red Willow Gage Stn. No. 06838000
- Medicine Creek below Harry Strunk Lake Gage Stn. No. 06842500

- Sappa Creek near Stamford Gage Stn. No. 06847500
- Prairie Dog Creek near Woodruff, Kansas Stn. No. 68-485000

+ CBCUc
+ CBCUn

+GWk
+ 0.6 x Dk
+ % x Pk
+ 0.5 x M&Ik
+ EvNFRk
+ Harlan County Lake Ev charged to Kansas
+Amount of transportation loss of the Courtland Canal above the Stateline that does not return to the river, charged to Kansas

- 0.9 x Red Willow Canal CBCU
- 0.9 x Hugh Butler Ev
- Harry Strunk Ev

+ 0.6 x Dn below Medicine Creek gage
+ % x Pn below Medicine Creek gage
+ 0.5 * M&In below Medicine Creek gage
+ EvNFRn below Medicine Creek gage

+ 0.6 x Dn below Beaver Creek gage
+ % x Pn below Beaver Creek gage
+ 0.5 * M&In below Beaver Creek gage
+ EvNFRn below Beaver Creek gage

+ 0.6 x Dn below Sappa Creek gage
+ % x Pn below Sappa Creek gage
+ 0.5 * M&In below Sappa Creek gage
+ EvNFRn below Sappa Creek gage

+ 0.6 x Dn below Prairie Dog Creek gage
+ % x Pn below Prairie Dog Creek gage
+ 0.5 * M&In below Prairie Dog Creek gage
+ EvNFRn below Prairie Dog Creek gage

+ Change in Storage Harlan County Lake
+ Change in Storage Swanson Lake

	- Nebraska Haigler Canal RF - 0.78 x Riverside Canal RF - 0.17 x Culbertson Canal RF - Culbertson Canal Extension RF to Main Stem + 0.24 x Meeker Driftwood Canal RF which returns to Driftwood Creek - 0.9 x Red Willow Canal RF + Courtland Canal at Kansas-Nebraska State Line Gage Stn No. 06852500 - Courtland Canal RF in Kansas above Lovewell Reservoir -IWS Notes: None of the Nebraska Haigler Canal RF returns to the North Fork of the Republican River 83% of the Culbertson Diversion RF and none of the Culbertson Extension RF return to Frenchman Creek 24 % of the Meeker Driftwood Canal RF returns to Driftwood Creek. 10% of the Red Willow Canal RF returns to Red Willow Creek Courtland Canal RF in Kansas above Lovewell Reservoir = 0.015 x (Courtland Canal at Kansas-Nebraska State Line Gage Stn No. 06852500)
CWS	= VWS - Change in Storage Harlan County Lake - Change in Storage Swanson Lake - FF
Allocation Kansas	= 0.511 x CWS
Allocation Nebraska	= 0.489 x CWS

V. Annual Data/ Information Requirements, Reporting, and Verification

The following information for the previous calendar year shall be provided to the members of the RRCA Engineering Committee by April 15th of each year, unless otherwise specified.

All information shall be provided in electronic format, if available.

Each State agrees to provide all information from their respective State that is needed for the RRCA Groundwater Model and RRCA Accounting Procedures and Reporting Requirements, including but not limited to the following:

A. Annual Reporting

1. Surface water diversions and irrigated acreage:

Each State will tabulate the canal, ditch, and other surface water diversions that are required by RRCA annual compact accounting and the RRCA Groundwater Model on a monthly format (or a procedure to distribute annual data to a monthly basis) and will forward the surface water diversions to the other States. This will include available diversion, wasteway, and farm delivery data for canals diverting from the Platte River that contribute to Imported Water Supply into the Basin. Each State will provide the water right number, type of use, system type, location, diversion amount, and acres irrigated.

2. Groundwater pumping and irrigated acreage:

Each State will tabulate and provide all groundwater well pumping estimates that are required for the RRCA Groundwater Model to the other States.

Colorado – will provide an estimate of pumping based on a county format that is based upon system type, Crop Irrigation Requirement (CIR), irrigated acreage, crop distribution, and irrigation efficiencies. Colorado will require installation of a totalizing flow meter, installation of an hours meter with a measurement of the pumping rate, or determination of a power conversion coefficient for 10% of the active wells in the Basin by December 31, 2005. Colorado will also provide an annual tabulation for each groundwater well that measures groundwater pumping by a totalizing flow meter, hours meter or power conversion coefficient that includes: the groundwater well permit number, location, reported hours, use, and irrigated acreage.

Kansas - will provide an annual tabulation by each groundwater well that includes: water right number, groundwater pumping determined by a meter on each well (or group of wells in a manifold system) or by reported hours of use and rate; location; system type (gravity, sprinkler, LEPA, drip, etc.); and irrigated acreage. Crop distribution will be provided on a county basis.

Nebraska – will provide an annual tabulation through the representative Natural Resource District (NRD) in Nebraska that includes: the well registration number or other ID number; groundwater pumping determined by a meter on each well (or group of wells in a manifold system) or by reported hours of use and rate; wells will be identified by; location; system type (gravity, sprinkler, LEPA, drip, etc.); and irrigated acreage. Crop distribution will be provided on a county basis.

3. Climate information:

Each State will tabulate and provide precipitation, temperature, relative humidity or dew point, and solar radiation for the following climate stations:

State	Identification	Name
Colorado		
Colorado	C050109	Akron 4 E
Colorado	C051121	Burlington
Colorado	C054413	Julesburg
Colorado	C059243	Wray
Kansas	C140439	Atwood 2 SW
Kansas	C141699	Colby 1SW
Kansas	C143153	Goodland
Kansas	C143837	Hoxie
Kansas	C145856	Norton 9 SSE
Kansas	C145906	Oberlin1 E
Kansas	C147093	Saint Francis
Kansas	C148495	Wakeeny
Nebraska	C250640	Beaver City
Nebraska	C250810	Bertrand
Nebraska	C252065	Culbertson
Nebraska	C252690	Elwood 8 S
Nebraska	C253365	Gothenburg
Nebraska	C253735	Hebron
Nebraska	C253910	Holdredge
Nebraska	C254110	Imperial
Nebraska	C255090	Madrid
Nebraska	C255310	McCook
Nebraska	C255565	Minden
Nebraska	C256480	Palisade
Nebraska	C256585	Paxton
Nebraska	C257070	Red Cloud
Nebraska	C258255	Stratton
Nebraska	C258320	Superior
Nebraska	C258735	Upland
Nebraska	C259020	Wauneta 3 NW

4. Crop Irrigation Requirements:

Each State will tabulate and provide estimates of crop irrigation requirement information on a county format. Each State will provide the percentage of the crop irrigation requirement met by pumping; the percentage of groundwater irrigated lands served by sprinkler or flood irrigation systems, the crop irrigation requirement; crop distribution; crop coefficients; gain in soil moisture from winter and spring precipitation, net crop irrigation requirement; and/or other information necessary to compute a soil/water balance.

5. Streamflow Records from State-Maintained Gaging Records:

Streamflow gaging records from the following State maintained gages will be provided:

Station No.	Name
00126700	Republican River near Trenton
06831500	Frenchman Creek near Imperial
06832500	Frenchman Creek near Enders
06835000	Stinking Water Creek near Palisade
06837300	Red Willow Creek above Hugh Butler Lake
06837500	Red Willow Creek near McCook
06841000	Medicine Creek above Harry Strunk Lake
06842500	Medicine Creek below Harry Strunk Lake
06844000	Muddy Creek at Arapahoe
06844210	Turkey Creek at Edison
06847000	Beaver Creek near Beaver City
	Republican River at Riverton
06851500	Thompson Creek at Riverton
06852000	Elm Creek at Amboy
	Republican River at the Superior-Courtland Diversion Dam

6. Platte River Reservoirs:

The State of Nebraska will provide the end-of-month contents, inflow data, outflow data, area-capacity data, and monthly net evaporation, if available, from Johnson Lake; Elwood Reservoir; Sutherland Reservoir; Maloney Reservoir; and Jeffrey Lake.

7. Water Administration Notification:

The State of Nebraska will provide the following information that describes the protection of reservoir releases from Harlan County Lake and for the administration of water rights junior in priority to February 26, 1948:

Date of notification to Nebraska water right owners to curtail their diversions, the amount of curtailment, and length of time for curtailment.
The number of notices sent.
The number of diversions curtailed and amount of curtailment in the Harlan County Lake to Guide Rock reach of the Republican River.

8. Moratorium:

Each State will provide a description of all new Wells constructed in the Basin Upstream of Guide Rock including the owner, location (legal description), depth and diameter or dimension of the constructed water well, casing and screen information, static water level, yield of the water well in gallons per minute or gallons per hour, and intended use of the water well.

Designation whether the Well is a:

a. Test hole;

b. Dewatering Well with an intended use of one year or less;

c. Well designed and constructed to pump fifty gallons per minute or less;

d. Replacement Water Well, including a description of the Well that is replaced providing the information described above for new Wells and a description of the historic use of the Well that is replaced;

e. Well necessary to alleviate an emergency situation involving provision of water for human consumption, including a brief description of the nature of the emergency situation and the amount of water intended to be pumped by and the length of time of operation of the new Well;

f. Transfer Well, including a description of the Well that is transferred providing the information described above for new Wells and a description of the Historic Consumptive Use of the Well that is transferred;

g. Well for municipal and/or industrial expansion of use;

Wells in the Basin in Northwest Kansas or Colorado. Kansas and Colorado will provide the information described above for new Wells along with copies of any other information that is required to be filed with either State of local agencies under the laws, statutes, rules and regulations in existence as of April 30, 2002, and;

Any changes in State law in the previous year relating to existing Moratorium.

9. Non-Federal Reservoirs:

Each State will conduct an inventory of Non Federal Reservoirs by December 31, 2004, for inclusion in the annual Compact Accounting. The inventory shall include the following information: the location, capacity (in Acre-feet) and area (in acres) at the principal spillway elevation of each Non-Federal Reservoir. The States will annually provide any updates to the initial inventory of Non-Federal Reservoirs, including enlargements that are constructed in the previous year.

Owners/operators of Non-Federal Reservoirs with 200 Acre-feet of storage capacity or greater at the principal spillway elevation will be required to provide an area-capacity survey from State-approved plans or prepared by a licensed professional engineer or land surveyor.

10. Augmentation Plan:

Each State will provide a description of the wells, measuring devices, conveyance structure(s), and other infrastructure to describe the physical characteristics of each augmentation plan. The States will provide necessary updates to the plan on an annual basis.

B. RRCA Groundwater Model Data Input Files

1. Monthly groundwater pumping, surface water recharge, groundwater recharge, and precipitation recharge provided by county and indexed to the one square mile cell size.

2. Potential Evapotranspiration rate is set as a uniform rate for all phreatophyte vegetative classes – the amount is X at Y climate stations and is interpolated spatially using kriging.

C. Inputs to RRCA Accounting

1. Surface Water Information

a. Streamflow gaging station records: obtained as preliminary USGS or Nebraska streamflow records, with adjustments to reflect a calendar year, at the following locations:

Arikaree River at Haigler, Nebraska
North Fork Republican River at Colorado-Nebraska state line
Buffalo Creek near Haigler, Nebraska
Rock Creek at Parks, Nebraska
South Fork Republican River near Benkelman, Nebraska
Frenchman Creek at Culbertson, Nebraska
Red Willow Creek near Red Willow, Nebraska
Medicine Creek below Harry Strunk Lake, Nebraska*
Beaver Creek near Beaver City, Nebraska*
Sappa Creek near Stamford, Nebraska
Prairie Dog Creek near Woodruff, Kansas
Courtland Canal at Nebraska-Kansas state line
Republican River near Hardy, Nebraska
Republican River at Superior-Courtland Diversion Dam near Guide Rock,
Nebraska (new)*

b. Federal reservoir information: obtained from the United States Bureau of Reclamation:

Daily free water surface evaporation, storage, precipitation, reservoir release information, and updated area-capacity tables.
Federal Reservoirs:
Bonny Reservoir
Swanson Lake
Harry Strunk Lake
Hugh Butler Lake
Enders Reservoir
Keith Sebelius Lake
Harlan County Lake
Lovewell Reservoir

c. Non-federal reservoirs obtained by each state: an updated inventory of reservoirs that includes the location, surface area (acres), and capacity (in Acre-feet), of each non-federal reservoir with storage capacity of fifteen (15) Acre-feet or greater at the principal spillway elevation. Supporting data to substantiate the average surface water areas that are different than the presumptive average annual surface area may be tendered by the offering State.

d. Diversions and related data from USBR

Irrigation diversions by canal, ditch, and pumping station that irrigate more than two (2) acres
Diversions for non-irrigation uses greater than 50 Acre-feet
Farm Deliveries
Wasteway measurements
Irrigated acres

e. Diversions and related data – from each respective State

Irrigation diversions by canal, ditch, and pumping station that irrigate more than two (2) acres
Diversions for non-irrigation uses greater than 50 Acre-feet
Wasteway measurements, if available

2. Groundwater Information

(From the RRCA Groundwater model as output files as needed for the accounting procedures)

a. Imported water - mound credits in amount and time that occur in defined streamflow points/reaches of measurement or compliance – ex: gaging stations near confluence or state lines

b. Groundwater depletions to streamflow (above points of measurement or compliance – ex: gaging stations near confluence or state lines)

3. Summary

The aforementioned data will be aggregated by Sub-basin as needed for RRCA accounting.

D. Verification

1. Documentation to be Available for Inspection Upon Request

a. Well permits/ registrations database
b. Copies of well permits/ registrations issued in calendar year
c. Copies of surface water right permits or decrees
d. Change in water right/ transfer historic use analyses
e. Canal, ditch, or other surface water diversion records
f. Canal, ditch, or other surface water measurements
g. Reservoir storage and release records
h. Irrigated acreage
i. Augmentation Plan well pumping and augmentation delivery records

2. Site Inspection

a. Accompanied – reasonable and mutually acceptable schedule among representative state and/or federal officials.

b. Unaccompanied – inspection parties shall comply with all laws and regulations of the State in which the site inspection occurs.

Table 1: Annual Virgin and Computed Water Supply, Allocations and Computed Beneficial Consumptive Uses by State, Main Stem and Sub-basin

Designated Drainage Basin	Col. 1: Virgin Water Supply	Col. 2: Computed Water Supply	Col. 3: Allocations				Col. 4: Computed Beneficial Consumptive Use		
			Colorado	Nebraska	Kansas	Unallocated	Colorado	Nebraska	Kansas
North Fork in Colorado									
Arikaree									
Buffalo									
Rock									
South Fork of Republican River									
Frenchman									
Driftwood									
Red Willow									
Medicine									
Beaver									
Sappa									
Prairie Dog									
North Fork of Republican River in Nebraska and Main Stem									
Total All Basins									
North Fork Of Republican River in Nebraska and Mainstem Including Unallocated Water									
Total									

Table 2: Original Compact Virgin Water Supply and Allocations

Designated Drainage Basin	Virgin Water Supply	Colorado Allocation	% of Total Drainage Basin Supply	Kansas Allocation	% of Total Drainage Basin Supply	Nebraska Allocation	% of Total Drainage Basin Supply	Unallo-cated	% of Total Drainage Basin Supply
North Fork - CO	44,700	10,000	22.4			11,000	24.6	23,700	53.0
Arikaree River	19,610	15,400	78.5	1,000	5.1	3,300	16.8	-90	-0.4
Buffalo Creek	7,890					2,600	33.0	5,290	67.0
Rock Creek	11,000					4,400	40.0	6,600	60.0
South Fork	57,200	25,400	44.4	23,000	40.2	800	1.4	8,000	14.0
Frenchman Creek	98,500					52,800	53.6	45,700	46.4
Driftwood Creek	7,300			500	6.9	1,200	16.4	5,600	76.7
Red Willow Creek	21,900					4,200	19.2	17,700	80.8
Medicine Creek	50,800					4,600	9.1	46,200	90.9
Beaver Creek	16,500	3,300	20.0	6,400	38.8	6,700	40.6	100	0.6
Sappa Creek	21,400			8,800	41.1	8,800	41.1	3,800	17.8
Prairie Dog Creek	27,600			12,600	45.7	2,100	7.6	12,900	46.7
Sub-total Tributaries	384,400							175,500	
Main Stem + Blackwood Creek	94,500								
Main Stem + Unallocated	270,000			138,000	51.1	132,000	48.9		
Total	478,900	54,100		190,300		234,500			

Table 3A: Table to Be Used to Calculate Colorado's Five-Year Running Average Allocation and Computed Beneficial Consumptive Use for Determining Compact Compliance

Colorado				
	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive	Imported Water Supply Credit	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit Col 1 – (Col 2- Col 3)
Year t= -4				
Year t= -3				
Year t= -2				
Year t= -1				
Current Year t= 0				
Average				

Table 3B. Table to Be Used to Calculate Kansas's Five-Year Running Average Allocation and Computed Beneficial Consumptive Use for Determining Compact Compliance

Kansas				
	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive	Imported Water Supply Credit	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit Col 1 – (Col 2- Col 3)
Year t= -4				
Year t= -3				
Year t= -2				
Year t= -1				
Current Year t= 0				
Average				

Table 3C. Table to Be Used to Calculate Nebraska's Five-Year Running Average Allocation and Computed Beneficial Consumptive Use for Determining Compact Compliance

Nebraska				
	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive	Imported Water Supply Credit and/or Augmentation Water Supply Credit	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit Col 1 – (Col 2- Col 3)
Year T= -4				
Year T= -3				
Year T= -2				
Year T= -1				
Current Year T= 0				
Average				

Table 4A: Colorado Compliance with the Sub-basin Non-impairment Requirement

	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
Sub-basin	Colorado Sub-basin Allocation (5-year running average)	Unallocated Supply (5-year running average)	Credits from Imported Water Supply (5-year running average)	Total Supply Available = Col 1+ Col 2 + Col 3 (5-year running average)	Colorado Computed Beneficial Consumptive Use (5-year running average)	Difference Between Available Supply and Computed Beneficial Consumptive Use = Col 4 – Col 5 (5-year running average)
North Fork Republican River Colorado						
Arikaree River						
South Fork Republican River						
Beaver Creek						

Table 4B: Kansas Compliance with the Sub-basin Non-impairment Requirement

	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Sub-basin	Kansas Sub-basin Allocation (5-year running average)	Unallocated Supply (5-year running average)	Unused Allocation from Colorado (5-year running average)	Credits from Imported Water Supply (5-year running average)	Total Supply Available = Col 1+ Col 2+ Col 3 + Col 4 (5-year running average)	Kansas Computed Beneficial Consumptive Use (5-year running average)	Difference Between Available Supply and Computed Beneficial Consumptive Use = Col 5 – Col 6 (5-year running average)
Arikaree River							
South Fork Republican River							
Driftwood Creek							
Beaver Creek							
Sappa Creek							
Prairie Dog Creek							

Table 5A: Colorado Compliance During Water-Short Year Administration

Colorado				
	Col. 1	Col. 2	Col. 3	Col 4
Year	Allocation minus Allocation for Beaver Creek	Computed Beneficial Consumptive minus Computed Beneficial Consumptive Use for Beaver Creek	Imported Water Supply Credit excluding Beaver Creek	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit for All Basins Except Beaver Creek Col 1 – (Col 2 – Col 3)
Year T= -4				
Year T= -3				
Year T= -2				
Year T= -1				
Current Year T= 0				
Average				

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

Kansas						
Year	Allocation			Computed Beneficial Consumptive Use`	Imported Water Supply Credit	Difference Between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit
Column	1	2	3	4	5	6
	Sum Sub-basins	Kansas's Share of the Unallocated Supply	Total Col 1 + Col 2			Col 3 – (Col 4 – Col 5)
Previous Year						
Current Year						
Average						

Table 5C: Nebraska Compliance During Water-Short Year Administration

Nebraska								
Year	Allocation			Computed Beneficial Consumptive Use			Imported Water Supply Credit and/or Augmentation Water Supply Credit	Difference Between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit Above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU below Guide Rock	State Wide CBCU above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
Previous Year								
Current Year								
Average								

Table 5D: Nebraska Compliance Under a Alternative Water-Short Year Administration Plan

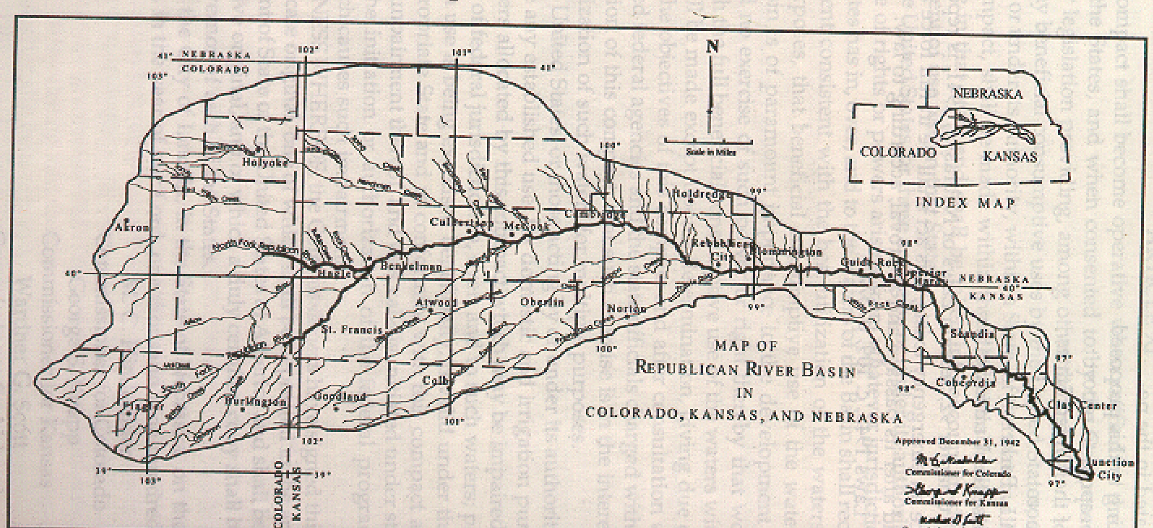
Year	Allocation			Computed Beneficial Consumptive Use			Imported Water Supply Credit and/or Augmentation Water Supply Credit	Difference Between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit and/or Augmentation Water Supply Credit Above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU below Guide Rock	State Wide CBCU above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6- Col 7)
Year = -2								
Year = -1								
Current Year								
Three-Year Average								
Sum of Previous Two-year Difference								
Expected Decrease in CBCU Under Plan								

Table 5E: Nebraska Tributary Compliance During Water-Short Year Administration

Year	Sum of Nebraska Sub-basin Allocations	Sum of Nebraska's Share of Sub-basin Unallocated Supplies	Total Available Water Supply for Nebraska	Computed Beneficial Consumptive Use	Imported Water Supply Credit and/or Augmentation Water Supply Credit	Difference between Allocation And the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit and/or Augmentation Water Supply Credit
	Col 1	Col 2	`Col 3	Col 4	Col 5	Col 6
Previous Year						Col 3 -(Col 4-Col 5)

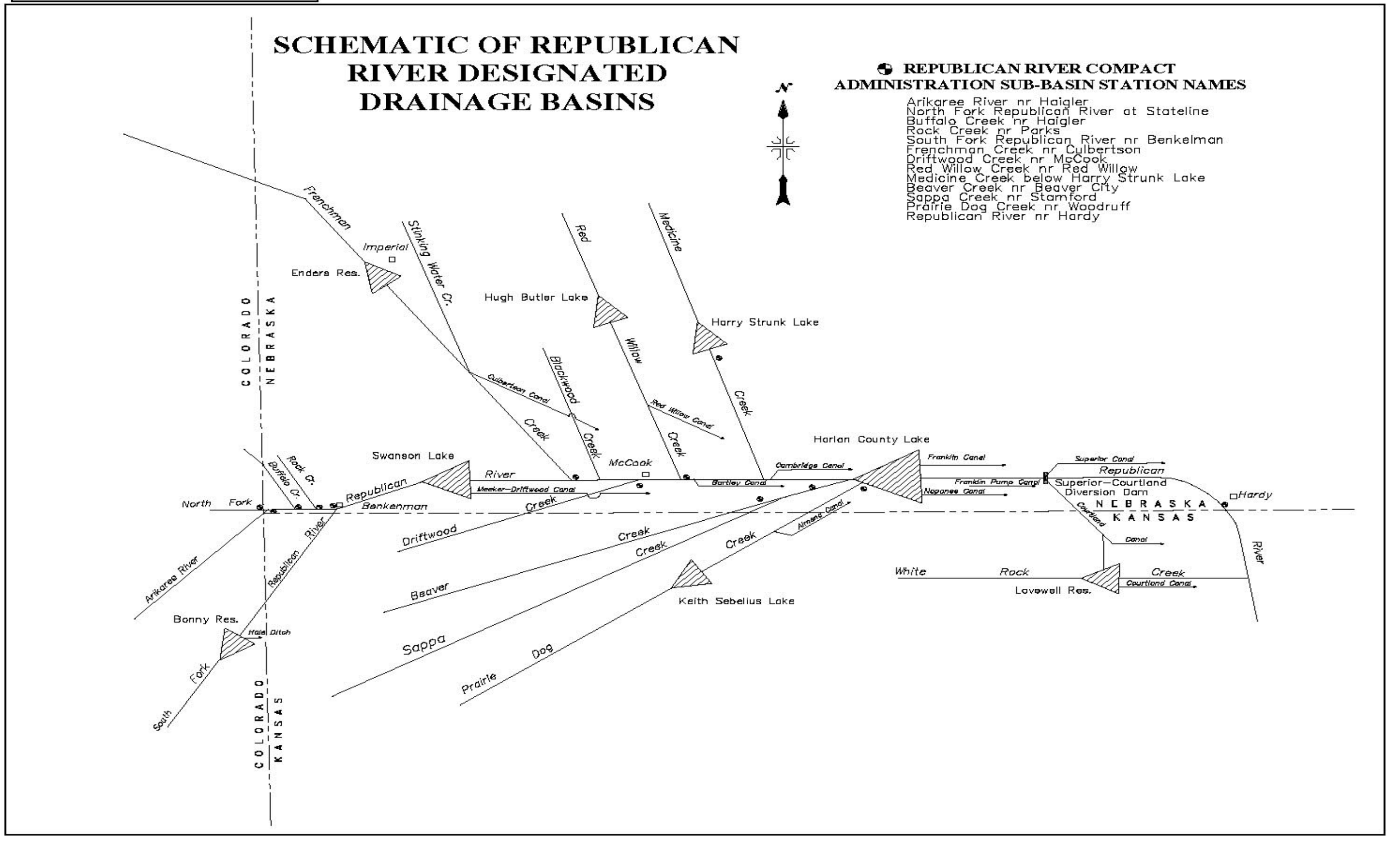
Current Year						
Average						

Figure 1

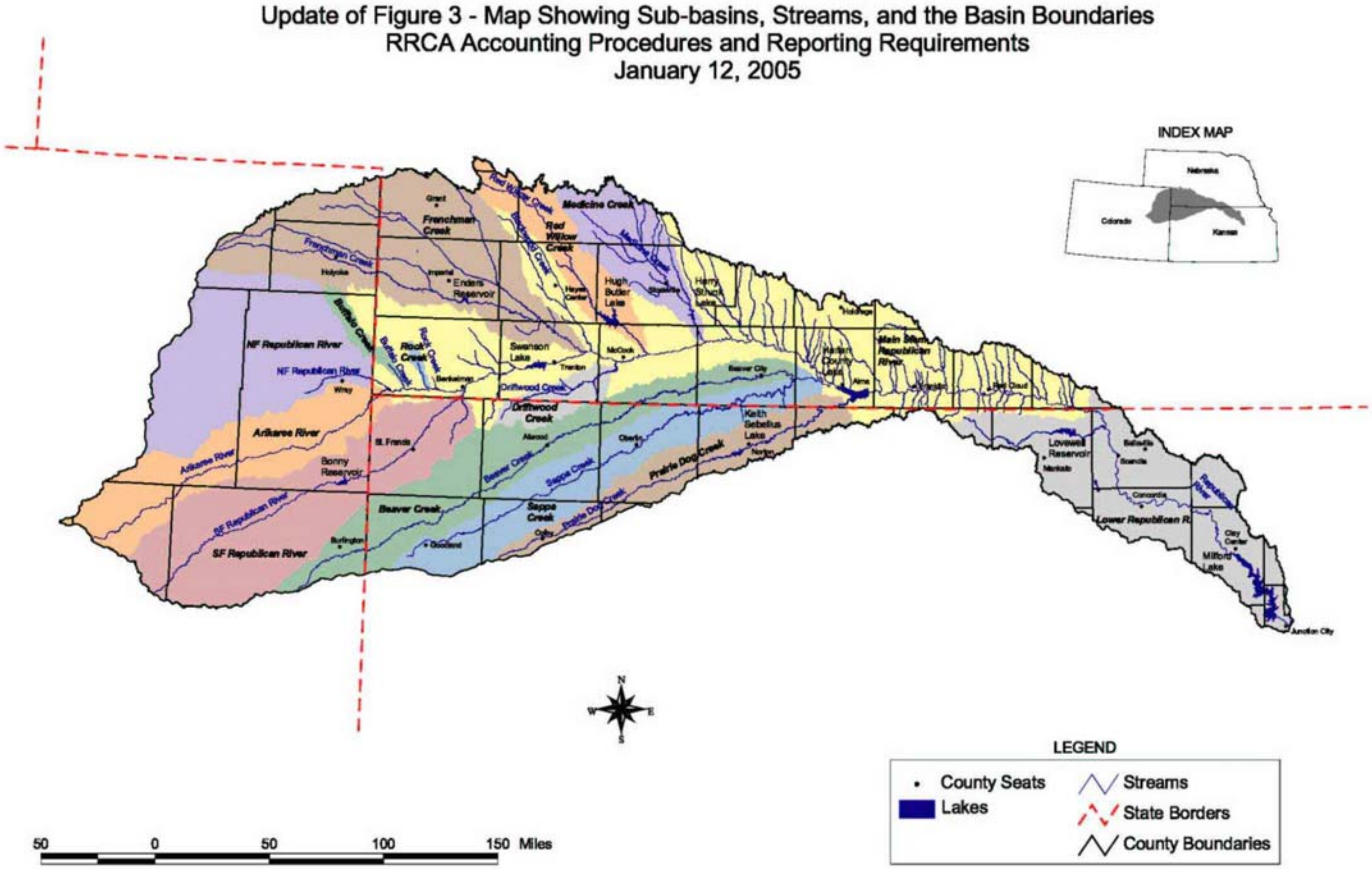


Basin Map Attached to Compact that Shows the Streams and the Basin Boundaries

Figure 2



Line Diagram of Designated Drainage Basins Showing Federal Reservoirs and Sub-basin Gaging Stations



Map Showing Sub-basins, Streams, and the Basin Boundaries

Attachment 1: Sub-basin Flood Flow Thresholds

Sub-basin	Sub-basin Flood Flow Threshold Acre-feet per Year[3]
Arikaree River	16,400
North Fork of Republican River	33,900
Buffalo Creek	4,800
Rock Creek	9,800
South Fork of Republican River	30,400
Frenchman Creek	51,900
Driftwood Creek	9,400
Red Willow Creek	15,100
Medicine Creek	55,100
Beaver Creek	13,900
Sappa Creek	26,900
Prairie Dog	15,700

[3] Flows considered to be Flood Flows are flows in excess of the 94% flow based on a flood frequency analysis for the years 1971-2000. The Gaged Flows are measured after depletions by Beneficial Consumptive Use and change in reservoir storage. For the purpose of compliance with III.B.1, the Gaged Flows shall not include Augmentation Water Supply Credits delivered in any calendar year.

Attachment 2: Description of the Consensus Plan for Harlan County Lake

The Consensus Plan for operating Harlan County Lake was conceived after extended discussions and negotiations between Reclamation and the Corps. The agreement shaped at these meetings provides for sharing the decreasing water supply into Harlan County Lake. The agreement provides a consistent procedure for: updating the reservoir elevation/storage relationship, sharing the reduced inflow and summer evaporation, and providing a January forecast of irrigation water available for the following summer.

During the interagency discussions the two agencies found agreement in the following areas:

- The operating plan would be based on current sediment accumulation in the irrigation pool and other zones of the project.
- Evaporation from the lake affects all the various lake uses in proportion to the amount of water in storage for each use.
- During drought conditions, some water for irrigation could be withdrawn from the sediment pool.
- Water shortage would be shared between the different beneficial uses of the project, including fish, wildlife, recreation and irrigation.

To incorporate these areas of agreement into an operation plan for Harlan County Lake, a mutually acceptable procedure addressing each of these items was negotiated and accepted by both agencies.

1. Sediment Accumulation.

The most recent sedimentation survey for Harlan County project was conducted in 1988, 37 years after lake began operation. Surveys were also performed in 1962 and 1972; however, conclusions reached after the 1988 survey indicate that the previous calculations are unreliable. The 1988 survey indicates that, since closure of the dam in 1951, the accumulated sediment is distributed in each of the designated pools as follows:

Flood Pool	2,387 Acre-feet
Irrigation Pool	4,853 Acre-feet
Sedimentation Pool	33,527 Acre-feet

To insure that the irrigation pool retained 150,000 Acre-feet of storage, the bottom of the irrigation pool was lowered to 1,932.4 feet, msl, after the 1988 survey.

To estimate sediment accumulation in the lake since 1988, we assumed similar conditions have occurred at the project during the past 11 years. Assuming a consistent rate of deposition since 1988, the irrigation pool has trapped an additional 1,430 Acre-feet.

A similar calculation of the flood control pool indicates that the flood control pool has captured an additional 704 Acre-feet for a total of 3,090 Acre-feet since construction.

The lake elevations separating the different pools must be adjusted to maintain a 150,000-acre-foot irrigation pool and a 500,000-acre-foot flood control pool. Adjusting these elevations results in the following new elevations for the respective pools (using the 1988 capacity tables).

Top of Irrigation Pool	1,945.70 feet, msl
Top of Sediment Pool	1,931.75 feet, msl

Due to the variability of sediment deposition, we have determined that the elevation capacity relationship should be updated to reflect current conditions. We will complete a new sedimentation survey of Harlan County Lake this summer, and new area capacity tables should be available by early next year. The new tables may alter the pool elevations achieved in the Consensus Plan for Harlan County Lake.

2. Summer Evaporation.

Evaporation from a lake is affected by many factors including vapor pressure, wind, solar radiation, and salinity of the water. Total water loss from the lake through evaporation is also affected by the size of the lake. When the lake is lower, the surface area is smaller and less water loss occurs. Evaporation at Harlan County Lake has been estimated since the lake’s construction using a Weather Service Class A pan which is 4 feet in diameter and 10 inches deep. We and Reclamation have jointly reviewed this information and assumed future conditions to determine an equitable method of distributing the evaporation loss from the project between irrigation and the other purposes.

During those years when the irrigation purpose expected a summer water yield of 119,000 Acre-feet or more, it was determined that an adequate water supply existed and no sharing of evaporation was necessary. Therefore, evaporation evaluation focused on the lower pool elevations when water was scarce. Times of water shortage would also generally be times of higher evaporation rates from the lake.

Reclamation and we agreed that evaporation from the lake during the summer (June through September) would be distributed between the irrigation and sediment pools based on their relative percentage of the total storage at the time of evaporation. If the sediment pool held 75 percent of the total storage, it would be charged 75 percent of the evaporation. If the sediment pool held 50 percent of the total storage, it would be charged 50 percent of the evaporation. At the bottom of the irrigation pool (1,931.75 feet, msl) all of the evaporation would be charged to the sediment pool.

Due to downstream water rights for summer inflow, neither the irrigation nor the sediment pool is credited with summer inflow to the lake. The summer inflows would be assumed passed through the lake to satisfy the water right holders. Therefore, Reclamation and we did not distribute the summer inflow between the project purposes.

As a result of numerous lake operation model computer runs by Reclamation, it became apparent that total evaporation from the project during the summer averaged about 25,000 Acre-feet during times of lower lake elevations. These same models showed that about 20 percent of the evaporation should be charged to the irrigation pool, based on percentage in storage during the summer months. About 20 percent of the total lake storage is in the irrigation pool when the lake is at elevation 1,935.0 feet, msl. As a result of the joint study, Reclamation and we agreed that the irrigation pool would be credited with 20,000 Acre-feet of water during times of drought to share the summer evaporation loss.

Reclamation and we further agreed that the sediment pool would be assumed full each year. In essence, if the actual pool elevation were below 1,931.75 feet, msl, in January, the irrigation pool would contain a negative storage for the purpose of calculating available water for irrigation, regardless of the prior year's summer evaporation from sediment storage.

3. Irrigation withdrawal from sediment storage.

During drought conditions, occasional withdrawal of water from the sediment pool for irrigation is necessary. Such action is contemplated in the Field Working Agreement and the Harlan County Lake Regulation Manual: "Until such time as sediment fully occupies the allocated reserve capacity, it will be used for irrigation and various conservation purposes, including public health, recreation, and fish and wildlife preservation."

To implement this concept into an operation plan for Harlan County Lake, Reclamation and we agreed to estimate the net spring inflow to Harlan County Lake. The estimated inflow would be used by the Reclamation to provide a firm projection of water available for irrigation during the next season.

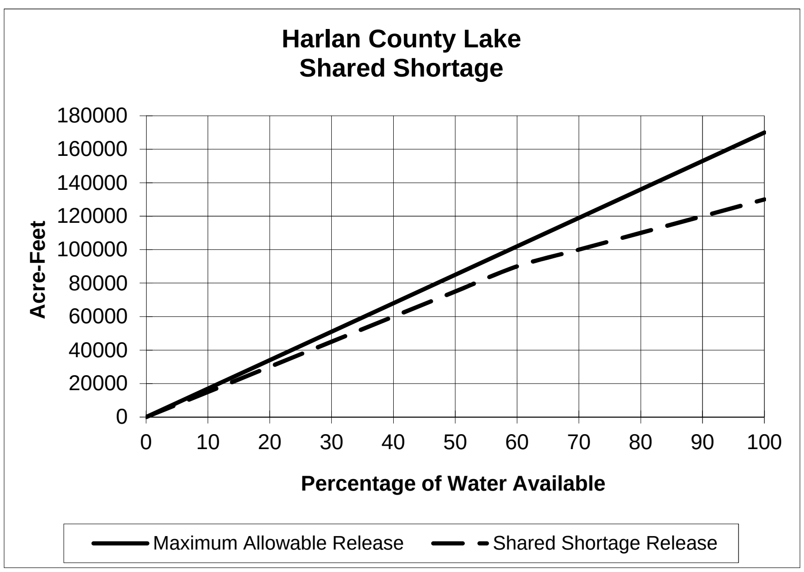
Since the construction of Harlan County Lake, inflows to the lake have been depleted by upstream irrigation wells and farming practices. Reclamation has recently completed an in-depth study of these depleted flows as a part of their contract renewal process. The study concluded that if the current conditions had existed in the basin since 1931, the average spring inflow to the project would have been 57,600 Acre-feet of water. The study further concluded that the evaporation would have been 8,800 Acre-feet of water during the same period. Reclamation and we agreed to use these values to calculate the net inflow to the project under the current conditions.

In addition, both agencies also recognized that the inflow to the project could continue to decrease with further upstream well development and water conservation farming. Due to these concerns, Reclamation and we determined that the previous 5-year inflow values would be averaged each year and compared to 57,600 Acre-feet. The inflow estimate for Harlan County Lake would be the smaller of these two values.

The estimated inflow amount would be used in January of each year to forecast the amount of water stored in the lake at the beginning of the irrigation season. Based on this forecast, the irrigation districts would be provided a firm estimate of the amount of water available for the next season. The actual storage in the lake on May 31 would be reviewed each year. When the actual water in storage is less than the January forecast, Reclamation may draw water from sediment storage to make up the difference.

4. Water Shortage Sharing.

A final component of the agreement involves a procedure for sharing the water available during times of shortage. Under the shared shortage procedure, the irrigation purpose of the project would remove less water then otherwise allowed and alleviate some of the adverse effects to the other purposes. The procedure would also extend the water supply during times of drought by "banking" some water for the next irrigation season. The following graph illustrates the shared shortage releases.



5. Calculation of Irrigation Water Available

Each January, the Reclamation would provide the Bostwick irrigation districts a firm estimate of the quantity of water available for the following season. The firm estimate of water available for irrigation would be calculated by using the following equation and shared shortage adjustment:

Storage + Summer Sediment Pool Evaporation + Inflow – Spring Evaporation=Maximum Irrigation Water Available

The variables in the equation are defined as:

- Maximum Irrigation Water Available. Maximum irrigation supply from Harlan County Lake for that irrigation season.
- Storage. Actual storage in the irrigation pool at the end of December. The sediment pool is assumed full. If the pool elevation is below the top of the sediment pool, a negative irrigation storage value would be used.
- Inflow. The inflow would be the smaller of the past 5-year average inflow to the project from January through May, or 57,600 Acre-feet.
- Spring Evaporation. Evaporation from the project would be 8,800 Acre-feet which is the average January through May evaporation.
- Summer Sediment Pool Evaporation. Summer evaporation from the sediment pool during June through September would be 20,000 Acre-feet. This is an estimate based on lower pool elevations, which characterize the times when it would be critical to the computations.

6. Shared Shortage Adjustment

To ensure that an equitable distribution of the available water occurs during short-term drought conditions, and provide for a "banking" procedure to increase the water stored for subsequent years, a shared shortage plan would be implemented. The maximum water available for irrigation according to the above equation would be reduced according to the following table. Linear interpolation of values will occur between table values.

Shared Shortage Adjustment Table

Irrigation Water Available (Acre-feet)	Irrigation Water Released (Acre-feet)
0	0
17,000	15,000
34,000	30,000
51,000	45,000
68,000	60,000
85,000	75,000
102,000	90,000
119,000	100,000
136,000	110,000
153,000	120,000
170,000	130,000

7. Annual Shutoff Elevation for Harlan County Lake

The annual shutoff elevation for Harlan County Lake would be estimated each January and finally established each June.

The annual shutoff elevation for irrigation releases will be estimated by Reclamation each January in the following manner:

1. Estimate the May 31 Irrigation Water Storage (IWS) (Maximum 150,000 Acre-feet) by taking the December 31 irrigation pool storage plus the January-May inflow estimate (57,600 Acre-feet or the average inflow for the last 5-year period, whichever is less) minus the January-May evaporation estimate (8,800 Acre-feet).
2. Calculate the estimated Irrigation Water Available, including all summer evaporation, by adding the Estimated Irrigation Water Storage (from item 1) to the estimated sediment pool summer evaporation (20,000 AF).
3. Use the above Shared Shortage Adjustment Table to determine the acceptable Irrigation Water Release from the Irrigation Water Available.
4. Subtract the Irrigation Water Release (from item 3) from the Estimated IWS (from item 1). The elevation of the lake corresponding to the resulting irrigation storage is the Estimated Shutoff Elevation. The shutoff elevation will not be below the bottom of the irrigation pool if over 119,000 AF of water is supplied to the districts, nor below 1,927.0 feet, msl. If the shutoff elevation is below the irrigation pool, the maximum irrigation release is 119,000 AF.

The annual shutoff elevation for irrigation releases would be finalized each June in accordance with the following procedure:

1. Compare the estimated May 31 IWS with the actual May 31 IWS.
2. If the actual end of May IWS is less than the estimated May IWS, lower the shutoff elevation to account for the reduced storage.
3. If the actual end of May IWS is equal to or greater than the estimated end of May IWS, the estimated shutoff elevation is the annual shutoff elevation.
4. The shutoff elevation will never be below elevation1,927.0 feet, msl, and will not be below the bottom of the irrigation pool if more than 119,000 Acre-feet of water is supplied to the districts.

Attachment 3: Inflows to Harlan County Lake 1993 Level of Development

BASELINE RUN - 1993 LEVEL INFLOW TO HARLAN COUNTY RESERVOIR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1931	10.2	10.8	13.4	5.0	18.8	15.8	4.3	1.8	1.8	0.0	0.1	0.1	82.1
1932	6.8	16.6	18.5	4.6	3.8	47.6	3.8	2.8	4.8	0.0	0.0	0.4	109.7
1933	0.4	0.0	3.9	30.2	31.0	5.4	1.8	0.0	10.4	0.0	2.6	5.5	91.2
1934	2.1	0.0	3.2	1.8	0.7	7.3	0.8	0.0	1.3	0.0	2.2	0.0	19.4
1935	0.3	0.1	0.7	4.2	0.8	389.3	6.1	19.1	26.1	2.4	5.2	0.9	455.2
1936	0.3	0.0	11.9	0.0	35.9	4.7	0.4	0.0	1.8	0.0	1.6	3.8	60.4
1937	4.8	12.9	6.0	2.5	0.0	12.6	6.3	6.9	2.4	0.0	0.0	12.4	66.8
1938	9.9	7.8	8.7	10.4	18.7	8.6	7.3	7.8	4.9	0.2	0.0	4.7	89.0
1939	2.7	7.5	9.6	12.2	6.6	13.3	5.0	4.1	0.0	0.0	0.0	0.0	61.0
1940	0.0	0.0	12.2	5.2	4.6	23.7	2.8	3.2	0.0	3.6	0.0	1.4	56.7
1941	0.0	10.6	10.6	7.7	17.2	67.1	28.9	19.7	14.9	8.3	6.7	7.1	198.8
1942	3.3	10.6	0.5	34.1	30.8	83.9	11.7	10.9	36.5	3.1	8.7	0.3	234.4
1943	1.2	11.2	14.6	31.4	4.7	28.3	4.8	0.3	0.9	0.0	0.0	11.8	109.2
1944	0.1	4.3	9.0	43.1	31.9	63.9	26.6	15.4	0.5	0.3	3.0	4.5	202.6
1945	4.3	7.8	5.7	9.5	4.1	53.5	5.0	0.9	1.5	5.0	6.0	6.3	109.6
1946	5.9	11.2	9.3	4.9	7.0	3.1	1.6	11.4	28.1	129.9	25.0	12.1	249.5
1947	1.1	3.2	10.4	8.2	11.9	195.4	22.3	5.9	2.9	0.2	0.3	0.3	262.1
1948	6.2	9.8	24.1	5.4	0.2	39.8	13.5	6.8	4.2	0.0	0.1	0.1	110.2
1949	2.0	1.5	25.2	16.3	49.0	57.4	9.2	5.5	2.1	3.0	2.8	0.3	174.3
1950	0.3	5.7	10.8	10.9	28.9	10.1	12.7	9.3	7.8	7.2	3.8	3.1	110.6
1951	3.8	3.4	7.1	5.3	42.0	39.9	42.1	10.1	36.0	15.5	14.8	8.9	228.9
1952	16.4	21.4	26.3	23.8	34.6	4.0	9.3	3.1	1.5	11.7	4.3	0.1	156.5
1953	1.8	4.6	5.3	3.3	15.1	9.5	1.8	0.2	0.0	0.0	2.8	0.1	44.5
1954	1.0	6.8	1.9	3.2	7.1	2.4	0.0	1.2	0.0	0.0	0.0	0.0	23.6
1955	0.0	4.0	6.3	4.8	2.9	6.4	2.7	0.0	1.4	0.0	0.0	0.0	28.5
1956	1.6	3.4	2.9	2.4	1.3	1.5	0.0	0.6	0.0	0.0	0.0	0.0	13.7
1957	0.0	4.1	6.2	12.8	3.5	62.4	21.3	1.2	2.0	3.4	4.5	4.7	126.1
1958	0.8	3.0	14.2	14.0	18.7	1.3	3.4	2.2	0.0	0.4	0.0	0.6	58.6
1959	1.9	15.4	16.4	8.5	13.6	4.2	1.4	1.2	0.0	4.3	1.0	4.5	72.4
1960	1.4	12.3	71.4	23.9	21.7	53.7	14.1	3.2	0.0	0.0	0.2	2.8	204.7
1961	2.3	6.4	7.7	7.4	26.5	24.0	7.2	4.9	0.0	2.3	4.8	1.7	95.2

Attachment 3: Inflows to Harlan County Lake 1993 Level of Development

BASELINE RUN - 1993 LEVEL INFLOW TO HARLAN COUNTY RESERVOIR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1962	4.5	9.1	16.2	9.9	14.4	42.6	41.6	21.1	2.3	8.7	8.3	5.7	184.4
1963	3.4	18.2	18.2	15.0	12.7	14.7	3.4	6.1	8.7	0.8	5.3	1.8	108.3
1964	5.4	7.6	8.3	8.4	9.9	11.9	7.2	6.5	2.4	1.9	1.4	2.3	73.2
1965	6.0	8.1	11.1	12.8	32.8	40.0	22.9	6.5	37.2	53.7	19.5	11.0	261.6
1966	8.9	21.4	15.7	11.4	12.0	34.7	12.4	2.5	3.5	5.4	6.8	5.7	140.4
1967	7.2	11.5	11.5	12.9	9.1	75.3	43.7	15.3	4.4	7.3	6.9	5.4	210.5
1968	3.9	10.2	8.5	11.6	10.8	12.5	3.1	2.7	1.6	2.0	4.3	3.4	74.6
1969	4.2	10.8	24.5	15.1	18.9	17.5	17.0	12.6	16.6	9.2	11.8	9.9	168.1
1970	3.5	8.7	8.5	10.5	11.1	7.7	4.6	3.2	0.5	3.3	4.7	4.5	70.8
1971	4.1	10.3	12.4	12.8	18.3	7.2	8.4	6.2	1.9	4.2	7.3	7.1	100.2
1972	5.5	8.1	9.2	8.3	14.8	8.5	6.5	4.4	0.1	2.9	7.6	4.1	80.0
1973	11.4	14.2	19.0	16.2	17.4	20.9	9.1	1.9	8.4	19.6	11.9	13.2	163.2
1974	13.2	13.4	12.0	14.3	15.4	17.2	5.5	0.0	0.0	0.0	4.9	5.5	101.4
1975	7.2	8.2	13.6	14.8	12.0	48.1	11.6	7.4	0.1	3.0	6.2	7.3	139.5
1976	7.0	10.2	10.1	16.0	12.1	3.5	2.2	1.8	0.9	1.0	3.2	3.1	71.1
1977	4.4	9.6	12.9	21.2	31.5	12.1	5.9	1.9	10.6	4.1	5.5	5.3	125.0
1978	5.0	6.5	20.6	12.9	11.8	3.8	0.0	1.0	0.0	0.0	0.3	1.6	63.5
1979	1.3	7.6	21.5	18.8	15.9	5.4	10.4	10.6	1.6	0.9	3.6	6.2	103.8
1980	5.7	9.3	11.6	15.2	10.4	2.1	2.5	0.0	0.0	0.0	2.5	2.2	61.5
1981	5.5	6.0	11.6	14.9	22.5	6.4	11.5	16.3	4.3	2.5	6.7	6.2	114.4
1982	5.3	12.5	17.9	14.3	26.8	27.1	8.9	2.7	0.0	6.5	6.3	15.5	143.8
1983	6.5	9.7	27.2	16.4	41.4	74.2	10.7	7.6	3.8	3.1	6.7	5.2	212.5
1984	6.8	14.6	17.2	32.9	40.6	15.5	8.1	4.5	0.0	5.5	4.8	6.2	156.7
1985	6.9	14.1	13.6	11.9	27.4	9.9	10.0	2.0	6.0	8.5	5.6	5.8	121.7
1986	9.1	9.4	12.2	11.7	34.3	13.0	13.5	4.6	3.3	5.9	5.4	7.1	129.5
1987	5.9	9.2	19.7	24.1	24.3	11.7	19.0	5.7	2.3	2.7	8.2	7.0	139.8
1988	6.2	13.7	11.6	15.2	15.2	7.0	17.9	10.4	0.6	2.0	5.9	5.4	111.1
1989	5.4	5.9	10.5	9.1	11.4	11.8	14.0	6.2	0.2	3.1	3.1	3.5	84.2
1990	6.6	7.7	13.2	9.7	15.5	1.4	4.3	10.7	0.6	3.2	2.0	2.7	77.6
1991	2.4	8.0	9.0	10.6	15.2	3.9	1.9	0.5	0.0	0.0	2.7	4.8	59.0
1992	8.0	8.8	12.7	8.5	4.5	6.1	6.5	9.4	2.4	6.9	6.7	5.2	85.7
1993	5.2	14.4	71.6	22.7	21.0	17.0	68.0	37.5	23.3	16.8	30.1	17.7	345.3
Avg	4.5	8.8	14.1	13.0	17.2	30.6	11.0	6.2	5.4	6.3	5.0	4.7	126.8

Attachment 4: Evaporation Loss Harlan County Lake 1993 Level of Development

BASELINE - 1993 LEVEL FLOWS - HARLAN COUNTY EVAPORATION

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1931	0.7	0.9	1.6	2.9	4.2	7.4	6.9	5.2	2.7	2.1	1.2	0.4	36.2
1932	0.6	0.8	1.5	2.7	4.1	5.0	6.8	5.0	2.7	2.1	1.2	0.4	32.9
1933	0.6	0.8	1.4	2.5	3.8	7.8	6.1	4.2	2.7	2.1	1.2	0.4	33.6
1934	0.6	0.8	1.4	2.4	4.5	6.5	8.0	6.2	2.7	2.0	1.2	0.4	36.7
1935	0.6	0.8	1.3	2.3	2.2	3.6	9.7	6.2	3.1	2.5	1.4	0.5	34.2
1936	0.7	0.9	1.6	2.9	5.5	6.8	8.7	6.5	2.7	2.1	1.2	0.4	40.0
1937	0.6	0.8	1.4	2.5	3.6	4.0	6.2	6.5	2.7	2.1	1.2	0.4	32.0
1938	0.6	0.9	1.5	2.7	3.4	4.9	6.5	5.7	2.7	2.1	1.2	0.4	32.6
1939	0.6	0.8	1.4	2.6	4.3	4.9	6.8	4.6	2.7	2.1	1.2	0.4	32.4
1940	0.6	0.8	1.4	2.4	3.5	5.0	6.5	4.6	2.7	2.1	1.2	0.4	31.2
1941	0.6	0.8	1.4	2.5	3.9	4.2	6.7	5.3	2.8	2.1	1.3	0.5	32.1
1942	0.6	0.9	1.5	2.8	4.0	5.2	8.3	5.1	3.2	2.5	1.5	0.5	36.1
1943	0.7	1.0	1.8	3.2	4.3	5.7	7.9	6.3	2.7	2.1	1.2	0.4	37.3
1944	0.6	0.8	1.4	2.7	4.2	5.3	7.0	5.8	3.5	2.6	1.5	0.5	35.9
1945	0.7	1.0	1.8	3.1	3.8	3.0	6.7	5.7	2.9	2.2	1.3	0.5	32.7
1946	0.6	0.9	1.6	2.8	3.5	5.1	5.6	4.4	2.9	2.7	1.8	0.6	32.5
1947	1.0	1.5	2.9	3.2	3.4	-1.2	5.8	5.3	3.7	1.7	0.5	0.1	27.9
1948	0.8	0.7	1.5	3.6	3.1	2.4	4.2	4.7	3.0	2.7	0.8	0.3	27.8
1949	0.1	0.9	0.7	1.8	1.1	0.7	6.5	4.1	3.1	1.7	1.5	0.4	22.6
1950	0.7	0.1	0.8	2.8	2.0	5.6	0.8	2.8	4.5	2.3	1.6	0.6	24.6
1951	0.5	0.2	2.1	0.7	-0.1	1.9	3.5	4.1	0.4	3.1	2.2	0.9	19.5
1952	1.1	1.2	1.9	2.5	5.2	6.2	1.5	3.4	3.6	2.9	1.1	-0.1	30.5
1953	0.5	1.0	1.5	2.9	4.7	4.5	4.6	6.6	5.3	3.3	0.1	0.0	35.0
1954	0.7	0.6	2.2	3.6	0.3	4.9	6.7	1.6	3.6	1.6	1.5	0.6	27.9
1955	0.5	1.0	2.1	4.6	3.4	-0.5	7.3	6.9	2.7	2.6	1.4	0.4	32.4
1956	0.6	1.1	1.9	2.8	3.9	4.5	5.0	3.7	4.7	3.7	1.3	0.5	33.7
1957	0.7	1.0	1.3	0.5	-0.6	-1.1	6.1	3.7	2.3	1.7	1.2	0.4	17.2
1958	0.7	0.1	1.0	0.6	2.3	4.4	1.0	1.9	3.3	3.3	1.0	0.6	20.2
1959	0.4	1.0	1.1	2.1	1.0	3.5	5.0	4.8	2.3	0.7	1.5	0.6	24.0
1960	0.1	0.7	2.0	2.7	0.9	0.1	4.9	3.6	3.9	2.0	1.3	0.4	22.6
1961	0.9	1.0	1.4	2.7	-1.1	0.6	5.1	2.9	1.2	2.4	0.7	0.1	17.9

Attachment 4: Evaporation Loss Harlan County Lake 1993 Level of Development

BASELINE - 1993 LEVEL FLOWS - HARLAN COUNTY EVAPORATION

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1962	0.6	0.6	0.9	3.7	3.4	1.5	0.3	1.6	2.0	2.0	1.7	0.3	18.6
1963	0.7	1.4	1.3	4.5	4.6	6.3	6.1	3.1	-0.8	2.7	1.5	0.4	31.8
1964	0.8	0.8	1.7	3.2	5.6	1.2	6.9	3.0	3.0	3.3	1.2	0.6	31.3
1965	0.4	0.7	1.2	2.8	1.5	-0.5	2.0	2.8	-3.9	1.7	2.1	0.4	11.2
1966	0.9	0.8	2.9	2.7	7.5	2.8	5.8	3.7	2.7	2.8	1.5	0.4	34.5
1967	0.7	1.2	2.5	3.0	2.0	-2.9	1.6	4.5	3.5	2.0	1.6	0.4	20.1
1968	0.9	1.2	2.8	2.6	3.2	4.9	4.7	1.8	2.3	0.7	1.2	0.2	26.5
1969	0.4	0.6	2.4	3.3	0.1	3.8	-0.7	2.9	2.2	-1.0	1.5	0.4	15.9
1970	0.7	1.4	2.3	2.8	4.7	4.4	6.5	5.9	0.9	1.0	1.5	0.7	32.8
1971	0.7	0.2	2.0	2.9	0.7	5.1	3.4	4.5	1.4	1.5	0.2	0.5	23.1
1972	0.8	1.3	2.0	1.7	1.1	0.0	3.3	1.8	2.1	1.7	-0.4	0.1	15.5
1973	0.5	1.1	-0.7	2.5	3.4	6.7	-1.7	4.2	-3.0	0.2	0.2	0.2	13.6
1974	0.7	1.5	2.6	1.5	3.7	2.5	9.1	2.6	3.4	1.4	1.1	0.3	30.4
1975	0.7	0.7	2.0	2.1	0.8	1.1	4.3	2.7	3.0	3.4	0.7	0.6	22.1
1976	0.8	1.2	1.7	0.7	1.5	5.0	5.9	5.7	-0.2	1.4	1.4	0.7	25.8
1977	0.7	1.3	0.2	1.1	0.0	4.6	4.0	0.6	2.0	1.6	1.0	0.4	17.5
1978	0.5	0.7	1.2	3.4	3.9	6.2	7.1	4.5	4.5	3.0	1.1	0.5	36.6
1979	0.5	0.6	1.1	3.9	4.4	4.6	3.5	5.1	4.1	2.8	1.4	0.7	32.7
1980	0.5	0.6	1.2	3.4	3.7	4.7	6.8	6.0	3.9	2.7	1.3	0.6	35.4
1981	0.5	0.6	1.2	3.8	3.2	4.8	4.2	3.7	2.9	1.7	1.3	0.7	28.6
1982	0.5	0.7	1.2	3.9	3.8	3.9	5.1	3.8	2.9	2.2	1.4	0.8	30.2
1983	0.5	0.7	1.4	2.9	4.2	5.3	8.6	7.2	4.6	1.8	1.5	0.6	39.3
1984	0.6	0.8	1.4	2.9	4.2	5.8	7.2	5.7	4.7	1.4	1.4	0.7	36.8
1985	0.5	0.7	1.3	2.3	4.0	4.5	5.6	3.5	3.8	1.5	1.5	0.7	29.9
1986	0.6	0.7	1.3	2.8	4.4	5.8	6.7	4.0	2.7	1.3	1.4	0.7	32.4
1987	0.5	0.8	1.3	3.1	4.2	6.2	6.9	3.5	3.1	2.2	1.4	0.7	33.9
1988	0.5	0.7	1.3	3.5	4.9	6.6	4.6	4.8	3.5	2.2	1.4	0.7	34.7
1989	0.5	0.7	1.2	4.2	4.5	4.4	4.8	3.6	3.0	2.5	1.4	0.7	31.5
1990	0.5	0.7	1.2	3.0	3.5	5.6	6.4	4.0	5.0	3.4	1.4	0.6	35.3
1991	0.5	0.7	1.2	2.8	3.3	5.5	6.0	5.0	5.1	3.2	1.3	0.6	35.2
1992	0.6	0.7	1.2	1.8	3.2	2.2	4.1	3.5	4.2	2.9	1.9	1.0	27.3
1993	0.6	0.5	1.0	2.2	3.1	4.6	4.2	4.9	4.5	4.4	3.1	1.2	34.3
Avg	0.6	0.8	1.5	2.7	3.2	3.9	5.3	4.3	2.8	2.2	1.3	0.5	29.1

Attachment 5: Projected Water Supply Spread Sheet Calculations

Trigger Calculations Based on Harlan County Lake Irrigation Supply	Units-1000 Acre-feet	Irrigation Trigger	119.0	Assume that during irrigation release season HCL Inflow = Evaporation Loss									
		Total Irrigation Supply	130.0										
		Bottom Irrigation	164.1										
		Evaporation Adjust	20.0										
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
1993 Level AVE inflow	6.3	5	4.7	4.5	8.8	14.1	13.0	17.2	30.6	11.0	6.2	5.4	126.8
1993 Level AVE evap	2.2	1.3	0.5	0.6	0.8	1.5	2.7	3.2	3.9	5.3	4.3	2.8	29.1
(1931-93)													
Avg. Inflow Last 5 Years	10.8	13.0	12.3	12.9	16.6	22.4	19.4	18.1	14.8	16.5	11.0	4.7	172.6

Year 2001-2002 Oct - Jun Trigger and Irrigation Supply Calculation									
Calculation Month	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
Previous EOM Content	236.5	235.9	238.6	242.9	248.1	255.1	263.8	269.6	276.2
Inflow to May 31	73.6	67.3	62.3	57.6	53.1	44.3	30.2	17.2	0.0
Last 5 Yrs Avg Inflow to May 31	125.6	114.8	101.7	89.5	76.6	59.9	37.5	18.1	0.0
Evap to May 31	12.8	10.6	9.3	8.8	8.2	7.4	5.9	3.2	0.0
Est. Cont May 31	297.3	292.6	291.6	291.7	293.0	292.0	288.1	283.6	276.2
Est. Elevation May 31	1944.44	1944.08	1944.00	1944.01	1944.11	1944.03	1943.72	1943.37	1942.77
Max. Irrigation Available	153.2	148.5	147.5	147.6	148.9	147.9	144.0	139.5	132.1
Irrigation Release Est.	120.1	117.4	116.8	116.8	118.1	117.1	116.8	116.8	116.8
Trigger - Yes/No	NO	YES	YES	YES	YES	YES	YES	YES	YES
130 kAF Irrigation Supply - Yes/No	NO	NO	NO	NO	NO	NO	NO	NO	NO

Attachment 5: Projected Water Supply Spread Sheet Calculations

Year 2002 Jul - Sep Final Trigger and Total Irrigation Supply Calculation				
Calculation Month		**Jul**	**Aug**	**Sep**
Previous EOM Irrigation Release Est.		116.8	116.0	109.7
Previous Month Inflow		5.5	0.5	1.3
Previous Month Evap		6.3	6.8	6.6
Irrigation Release Estimate		116.0	109.7	104.4
Final Trigger - Yes/No		YES		
130 kAF Irrigation Supply - Yes/No		NO	NO	NO

Attachment 6: Computing Water Supplies and Consumptive Use Above Guide Rock

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Total Main Stem VWS	Hardy gage	Superior-Courtland Diversion Dam Gage	Courtland Canal Diversions	Superior Canal Diversions	Courtland Canal Returns	Superior Canal Returns	Total Bostwick Returns Below Guide Rock	NE CBCU Below Guide Rock	KS CBCU Below Guide Rock	Total CBCU Below Guide Rock	Gain Guide Rock to Hardy	VWS Guide Rock to Hardy	Main Stem Virgin Water Supply Above Guide Rock	Nebraska Main Stem Allocation Above Hardy	Kansas Main Stem Allocation Above Hardy	Nebraska Guide Rock to Hardy Allocation	Kansas Guide Rock to Hardy Allocation
							Col F+ Col G			Col I + Col J	+ Col B - Col C+ Col K - Col H	+ Col L + Col K	Col A - Col M	.489 x Col N	.511 x Col N	.489 x Col M	.511 x Col M

Attachment 7: Calculations of Return Flows from Bureau of Reclamation Canals

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11
Canal	Canal Diversion	Spill to Waste-way	Field Deliveries	Canal Loss	Average Field Loss Factor	Field Loss	Total Loss from District	Percent Field and Canal Loss That Returns to the Stream	Total Return to Stream from Canal and Field Loss	Return as Percent of Canal Diversion
Name Canal	Headgate Diversion	Sum of measured spills to river	Sum of deliveries to the field	+Col 2 - Col 4	1 -Weighted Average Efficiency of Application System for the District*	Col 4 x Col 6	Col 5 + Col 7	Estimated Percent Loss*	Columns 8 x Col 9	Col 10/Col 2
Example	100	5	60	40	30%	18	58	82%	48	48%
Culbertson					30%					
Culbertson Extension					30%					
Meeker-Driftwood					30%					
Red Willow					30%					
Bartley					30%					
Cambridge					30%					
Naponne					35%					
Franklin					35%					
Franklin Pump					35%					
Almena					30%					
Superior					31%					
Nebraska Courtland					23%					
Courtland Canal Above Lovewell (KS)					23%					
Courtland Canal Below Lovewell					23%					

*The average field efficiencies for each district and percent loss that returns to the stream may be reviewed and, if necessary, changed by the RRCA to improve the accuracy of the estimates.

Appendix B

Model Documentation and Model Files

The contents of Appendix B can be found at:

ftp://ftp.dnr.ne.gov/

login:	rrca
password	eLabor8ate

Exhibit B

Time Frame Designation

Nebraska v. Kansas and Colorado

(Rock Creek Augmentation)

Nebraska Formally Submits to RRCA for Resolution	Friday, 02/08/13
Special RRCA Meeting and Vote on Resolution	Sunday, 03/10/13
If Necessary…	
Nebraska Formally Submits the Issue to Arbitration	Monday, 03/11/13
Kansas and Colorado May Amend the Scope of the Dispute	Monday, 03/25/13
States Exchange List of Proposed Arbitrators	Monday, 04/08/13
States Meet and Confer on Arbitrator Selection	Wednesday, 04/17/13
CDR Selects Arbitrator (*If Necessary*)	Wednesday, 04/17/13
Hold Initial Arbitrator Conference and Set Schedule	Friday, 04/26/13
Final Day of Arbitration Hearings	Wednesday, 08/21/13
Complete Arbitration / Issue Decision	Wednesday, 10/23/13