Calculation of Computed Beneficial Consumptive Use and Imported Water Supply Credit Using the RRCA Groundwater Model

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Introduction

The state of Nebraska has raised an issue with the Republican River Compact Administration (RRCA) regarding the calculation of the Imported Water Supply Credit (Mound Credit) and groundwater Computed Beneficial Consumptive Use (CBCU) of the Virgin Water Supply (VWS) using the RRCA groundwater model. The relevant language in the Republican River Final Settlement Stipulation (FSS) can be found in Section IV.F.

> *Beneficial Consumptive Use of Imported Water Supply shall not count as Computed Beneficial Consumptive Use or Virgin Water Supply. Credit shall be given for any remaining Imported Water Supply that is reflected in increased stream flow, except as provided in Subsection V.B. Determinations of Beneficial Consumptive Use from Imported Water Supply (whether determined expressly or by implication), and any Imported Water Supply Credit shall be calculated in accordance with the RRCA Accounting Procedures and by using the RRCA Groundwater Model.*

Groundwater Modeling Scenarios

The RRCA groundwater model was developed to calculate base-flow to the Republican River. It was intended to be used to estimate impacts of changes to the ground water system on discharge of base-flow to the Republican River. Two scenarios, one in which a process (such as importation of water or groundwater pumping) is represented and another in which the process is not represented, would reveal the impact of the process on base-flow to the Republican River. The difference in calculated base-flow to the river between the two scenarios represents the magnitude of the impact. For example the following is a list of scenarios which may be used to evaluate the impacts of importing water and pumping:

Scenario (1) **Importation of Water On, Pumping On:** The recharge of Platte River water via surface water canals and irrigation is turned ON in the model, and the groundwater pumping throughout the model domain is turned ON.

Scenario (2) **Importation of Water Off, Pumping On:** The recharge of Platte River water via surface water canals and irrigation is turned OFF in the model, and the groundwater pumping throughout the model domain is turned ON

Scenario (3) **Importation of Water On, Pumping Off:** The recharge of Platte River water via surface water canals and irrigation is turned ON in the model, and the groundwater pumping throughout the model domain is turned OFF.

Scenario (4) **Importation of Water Off, Pumping Off:** The recharge of Platte River Water via surface water canals and irrigation is turned OFF in the model, and the groundwater pumping **throughout** the model domain is turned OFF.

There are several scenarios that can be selected to calculate the impact of a process on base-flow to the Republican River. Table A shows five options for scenario combinations which might be used to calculate impacts. For example: to calculate the impact of the importation of water on baseflow one could compare the difference between the importation of water on or off with the groundwater pumping on (Option 1) or with the groundwater pumping off (Option 2). Likewise, to calculate the impact of groundwater pumping on baseflow, one could compare the difference between pumping groundwater or not with the importation of water on (Option C) or with the importation of water off (Option D).

Table A - Options of calculations using groundwater modeling scenarios to calculate impacts of importation of water, groundwater pumping, or both.

Option	Calculation	Expected Results	Average Difference 1981-2000 (ac-ft/yr)	Average Difference 2001-2006 (ac-ft/yr)
A	**Scenario (1) – Scenario (2)** Importation On, Pumping On – Importation Off, Pumping On	Mound Credit	16,272	12,869
B	**Scenario (3) – Scenario (4)** Importation On, Pumping Off – Importation Off, Pumping Off	Mound Credit	21,655	28,359
C	**Scenario (1) – Scenario (3)** Importation On, Pumping On – Importation On, Pumping Off	Groundwater CBCU	210,127	251,841
D	**Scenario (2) – Scenario (4)** Importation Off, Pumping On – Importation Off, Pumping Off	Groundwater CBCU	204,740	236,352
E	**Scenario (1) – Scenario (4)** Importation On, Pumping On – Importation Off, Pumping Off	Total Impact	188,472	223,483

Both options A and B can be used to estimate the impact of importation of water on base-flow to the Republican River. There are differences, however, between the resulting estimates. Option A yields an estimate of 16,278 Acre-feet per year on average for the years 1981- 2000; option B yields an estimate of 21,655 Acre-feet per year. The difference in the estimates is substantial. They can be attributed to the fact that the model is non-linear.

Similarly options C and D can be used to estimate the impact of pumping. Option C yields an estimate of 210,127 Acre-feet per year on average for the years 1981-2000 and option D yields an estimate of 204,740 Acre-feet per year for the same period. Option E is the only choice of runs that can be used to estimate the total impact of importing water and pumping. It yields an estimate of 188,472 Acre-feet per year on average for the years 1981-2000.

The difference in estimates for impacts from importing water indicates that there is a significant error in one estimate or both. There is no reason to believe option A yields a better estimate of the impact of importing water than option B.

Obviously, a choice has to be made between the two available options for calculating the mound credit and two available methods for calculating the groundwater CBCU. The methods that are chosen should satisfy at least two criteria; (1) they should be in line with the intentions of the FSS, and (2) they should produce results for the mound credit and groundwater CBCU that when combined, are equal to (or very closely equal to) the total impacts to the Republican River base-flow (option E above, or Kansas' "virgin water supply metric"). Currently the accounting procedures use choice A and C to calculate the impacts of the imported water supply and ground water pumping on base-flow. However, the use of option B to calculate the IWS credit and option C to calculate the CBCU results in a combined impact for the IWS credit and CBCU equal to the result from method E and thus would seem to be the preferred method.

Nebraska accepted the model as the basis for allocation in spite of the fact that it was known to be non-linear. The fact that option A under-represents the mound credit during the current drought is injurious to Nebraska. According to the FSS, Section I.F, "The RRCA may modify the RRCA Accounting Procedures, or any portion thereof, in any manner consistent with the Compact and this Stipulation." The State of Nebraska continues to believe that the choice of model runs used to calculate the mound credit violates the letter and the spirit of the FSS, and should be changed within the Accounting Procedures in Appendix C.