# 2021 Forecast of Allowable Depletions in the Republican River Basin

*Nebraska Department of Natural Resources*
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## Background

The State of Nebraska is party to an interstate compact for the management of the Republican River Basin with the states of Colorado and Kansas, administered by the Republican River Compact Administration (RRCA). Pursuant to the current integrated management plans (IMPs) and Neb. Rev. Stat. § 46-715(6), the Nebraska Department of Natural Resources (NeDNR) in consultation with the Lower Republican Natural Resources District, Middle Republican Natural Resources District, and Upper Republican Natural Resources District (Districts) is required to provide an annual short-term and long-term forecast of maximum allowable depletions to streamflow that will ensure compliance with interstate compacts. The NeDNR has determined that the short-term forecast applies to the upcoming year (2021) and that the long-term forecast estimates what conditions may be ten years into the future. Therefore, this document includes the dry-year forecast of allowable depletions to streamflow in 2021 and 2031.

The States of Nebraska, Colorado, and Kansas, acting through the RRCA, adopted a *"Resolution Approving Long-Term Agreements Related to the Operation of Harlan County Lake for Compact Call Years*" (Resolution). The August 24, 2016, Resolution outlines certain actions that Nebraska will take toward Republican River Compact (Compact) compliance during years forecast as Compact Call Years as outlined in the Monitoring sections of the District IMPs. Compliance with the terms of the Resolution constitutes compliance with the Final Settlement Stipulation and Compact.

## Short-Term Forecast

The outcome of Nebraska's short-term forecast is largely dependent on three key elements, much of which are from data secured through the RRCA Compact accounting procedures. These three elements are detailed in the following sections.

### 1. Applicable compliance tests for 2021

The first key element of the short-term forecast is the identification of the averaging period that will be utilized for assessing compliance for the upcoming year. The compliance tests use five-year averaging upstream of Hardy in every year and may also include an additional test based on two-year averaging upstream of Guide Rock. The averaging period and applicable accounting points are determined based on projections of the total irrigation water supplies available to the Nebraska Bostwick Irrigation District and Kansas Bostwick Irrigation District. The current projection is that 2021 will require the use of five-year averaging to measure Nebraska's Compact compliance upstream of Hardy, but that the additional test of two-year averaging upstream of Guide Rock will not apply.

## 2. Previous year balances

The second key element in the short-term forecast is an evaluation of the recent Compact accounting balances for the State of Nebraska as determined using the current RRCA accounting procedures. These procedures allow for the determination of Nebraska's Compact balance for years through the current year (2020). Nebraska's Compact balances through 2019 have been approved and finalized by the RRCA. The 2020 balances are provisional. The information used to estimate the 2020 Compact balances are presented in Table 1. Nebraska's 2016-2018 RRCA-approved balances upstream of Hardy and Nebraska's 2019 RRCA-approved balances and 2020 provisional balances upstream of Guide Rock and Hardy are presented in Table 2.

Table 1. Information Used (acre-feet) for 2020 provisional Accounting.

| Item | Information Source |
|---|---|
| Groundwater Use | Prior years' pumping records |
| Surface Water Use | Estimated from preliminary data and previous years values |
| Stream Flow | Provisional records, end-of-year estimated |
| Evaporation | T-1 and provisional, end-of-year estimated records |

Table 2. Nebraska's 2016, 2017, 2018, and 2019 RRCA-approved balances and 2020 provisional balances upstream of Guide Rock and Hardy, as applicable to the forecast.

| Year | RRCA Status | Upstream of Guide Rock Balance* | Upstream of Hardy Balance |
|---|---|---|---|
| 2016 | Approved | - | 23,600 |
| 2017 | Approved | - | 35,800 |
| 2018 | Approved | - | 1,500 |
| 2019 | Approved | 100,000 | 153,000 |
| 2020 | Nebraska Provisional | 51,800 | 65,600 |
| 2019-2020 Balance | | 151,700 | - |
| 2016-2020 Balance | | - | 256,000 |

* Balances for upstream of Guide Rock are included but not applicable for 2020 compliance.
Note: Values are rounded to the nearest one hundred acre-feet. 2020 values are preliminary and have not been approved by the RRCA.

### 3. Forecast of available water supplies and consumption for 2021

The third key element is the forecast of available water supplies and consumption within Nebraska for the upcoming year. To carry out this forecast, NeDNR uses a simplified method of estimating the streamflow-related available water supply of the Republican River Basin for Nebraska's use. The water supply is related to eight variables:

- Surface water consumptive use in Colorado,
- Surface water consumptive use in Kansas,
- Surface water consumptive use in Nebraska,
- Groundwater consumptive use in Colorado,
- Groundwater consumptive use in Kansas,
- Groundwater consumptive use in Nebraska,
- Nebraska's Imported Water Supply Credit, and
- Surface water flow at the Kansas – Nebraska state line.

These eight variables may be estimated for the next year:

- Surface water consumption in Colorado is estimated using a two-year average,
- Surface water consumption in Kansas is related to the water available for irrigation in Harlan County Lake at the end of each year,
- Surface water consumption in Nebraska is related to water available for irrigation in the five Bureau of Reclamation project reservoirs in Nebraska at the start of each year,
- Groundwater consumption and the Imported Water Supply Credit are estimated in all three states using a two-year average, and
- Streamflow is estimated assuming that the upcoming year is a dry year and is based on the volume of water in Harlan County Lake and the most recent five years of streamflow.

Historically, Nebraska's share of the available water supply has been approximately half of the total water supply calculated using these methods. The information used to estimate the forecast of the available water supply and allowable depletions for 2021 are summarized in Table 3.

Table 3. Information Used (acre-feet) for 2021 Forecast of Allowable Depletions.

| Year | Item | Information Source |
|---|---|---|
| 2021 Forecast | Groundwater Consumptive Use and Imported Water Supply Credit | Average of 2019 and 2020 |
| | Surface Water Consumptive Use | Colorado: Previous two-year average |
| | | Kansas: + (.1858 x HCL content) + 9,575 |
| | | Nebraska: - (0.0000004) x (NE lake volume)$^2$ + (0.5151) x (NE lake volume) - 41,518 |
| | Stream Flow | + (5-year average of state line flows) x 0.41 + 0.23 x HCL content - 27,450 |

Utilizing the data sources outlined in Table 3, the required components of the forecast can be calculated (Table 4).

Table 4. 2021 Forecast values in acre-feet, where GWCBCU is defined as groundwater computed beneficial consumptive use and SWCBCU is defined as surface water computed beneficial consumptive use.

| Forecast Component | Forecast Value Upstream of Guide Rock | Forecast Value Upstream of Hardy |
|---|---|---|
| Colorado GWCBCU | 31,000 | 31,000 |
| Kansas GWCBCU | 18,900 | 18,900 |
| Nebraska GWCBCU | 202,800 | 204,700 |
| Nebraska Imported Water Supply Credit | 23,300 | 23,300 |
| Colorado SWCBCU | 200 | 200 |
| Kansas SWCBCU | 61,200 | 61,200 |
| Nebraska SWCBCU | 98,500 | 98,600 |
| Streamflows | 131,400 | 152,300 |

The 2021 Compact balances – of allocations (available water supply), computed beneficial consumptive use (CBCU, groundwater and surface water consumption), and Imported Water Supply Credit – are calculated from the forecast procedures contained in the Monitoring and Studies Section of the IMPs (Table 5).

Table 5. Forecast 2021 Allocations (available water supply), Computed Beneficial Consumptive Use (CBCU, groundwater and surface water consumption), Imported Water Supply Credit, and Compact Balances for Guide Rock and Hardy in acre-feet.

| Year | Allocation | Computed Beneficial Consumptive Use | Imported Water Supply Credit | Allocation - CBCU + IWS Credit (Balance) |
|---|---|---|---|---|
| 2021 Forecast upstream of Guide Rock | 272,000 | 301,300 | 23,300 | -6,000 |
| 2021 Forecast upstream of Hardy | 283,500 | 303,400 | 23,300 | 3,400 |

Note: Values are rounded to the nearest one hundred acre-feet.

Combining the results from the three key elements (applicable compliance test for 2021, previous years' balances, and forecast of available water supplies and consumption for 2021), Nebraska's 2017-2021 five-year total balance upstream of Hardy is forecast to be positive, and the additional two-year averaging test upstream of Guide Rock will not be applicable (Table 6).

Table 6. 2017-2019 approved Compact balance total upstream of Hardy, 2020 provisional balances upstream of Guide Rock and Hardy, and 2021 forecast balances upstream of Guide Rock and Hardy in acre-feet.

| Year | Upstream of Guide Rock Balance* | Upstream of Hardy Balance |
|---|---|---|
| 2017-2019 total, approved | - | 190,400 |
| 2020, provisional | 51,800 | 65,600 |
| 2021, forecast | -6,000 | 3,400 |
| Two-year (2020-2021) Total | 45,700 | - |
| Five-year (2017-2021) Total | - | 259,400 |

* Balances for upstream of Guide Rock are included but not applicable for 2021 compliance.
Note: Values are rounded to the nearest one hundred acre-feet. 2020 values are preliminary and have not been approved by the RRCA.

**Compact Call Year Evaluation**

The Monitoring sections of the District IMPs specifies the process that will be completed by NeDNR to determine Compact Call Years. The process is completed in a flowchart/checklist manner until a determination of whether or not the following year will be a Compact Call Year is made. Based on review of the IMP checklist with the information presented in the previous sections of this document, a Compact Call Year designation is not required for 2021.

**Review of Resolution Provisions**

2020 was not designated as a Compact Call Year. The balance of RCCV was equal to 9,300 acre-feet on January 1, 2020, and was immediately reduced by 20%. An equal volumetric reduction (1,860 acre-feet) will be applied to the balance of RCCV for each of the four subsequent years. On January 1, 2021, RCCV will be reduced to 5,580 acre-feet.

**Summary of the Short-Term Forecast for 2021**

Nebraska's 2021 compliance will be measured by the five-year average upstream of Hardy which is projected to be positive. Therefore, the Districts are not expected to have any Compact Call Year obligations for 2021. Additionally, District obligations related to RCCV from previous year carry-over will be reduced as illustrated in Table 7.

Table 7. Remaining Compact Compliance Volume obligation for each District within the Basin in acre-feet after January 1, 2021.

| Year | LRNRD | MRNRD | URNRD |
|---|---|---|---|
| Total Remaining Compact Compliance Volume | 2,460 | 2,760 | 360 |

## Long-Term Forecast

Due to the absence of a long-term trend in water supply, the periods of low water supplies in the future are likely to be similar to periods of low water supplies from the past. Historically, the minimum water supplies that have been available to Nebraska were approximately 200,000 acre-feet. Therefore, the amount of water that may be available from streamflow for beneficial use ten years in the future (2031), assuming several consecutive dry years, is estimated to be approximately 200,000 acre-feet. In an effort to continue to ensure long-term Compact compliance through future dry years, the Compliance Standards in the IMPs outline objectives to maintain groundwater depletions at a relatively constant level over the long-term. The NeDNR and Districts will continue to evaluate the trends in long-term groundwater depletions over typical wet and dry cycles and jointly assess whether additional management actions are necessary to accomplish this objective.