Minutes

Sixth Annual Meeting
Republican River Basin-Wide Plan

In-Person: Imperial, NE
Virtual: Zoom
November 13, 2024
1:00 P.M. Mountain Time

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Attendance

Twenty-five people were in attendance. Those that signed in or attended virtually are listed below.

Meeting Participants

Nebraska Department of Natural Resources (NeDNR):

Elizabeth Esseks (NeDNR)

Jennifer Schellpeper (NeDNR)

Kari Burgert (NeDNR)

Sam Capps (NeDNR)

Stefan Remund (NeDNR)

Natural Resources Districts (NRDs):

Alex Boyce (Middle Republican NRD)

Jack Russell (Middle Republican NRD)

Jasper Fanning (Upper Republican NRD)

John Thorburn (Tri-Basin NRD)

Nate Jenkins (Upper Republican NRD)

Nick Simonson (Lower Republican NRD)

Sylvia Johnson (Middle Republican NRD)

Todd Siel (Lower Republican NRD)

Valerie Paul, (Upper Big Blue NRD)

Other Attendees:

Brad Edgerton (Frenchman-Cambridge Irrigation District)

Brett Roberg (Nebraska Game and Parks)

Chance Thayer (The Flatwater Group)

Chelsea Erikson (Kansas Division of Water Resources)

Dale Cramer (Frenchman-Cambridge Irrigation District)

Dusty Way (Central Nebraska Public Power and Irrigation District)

Eric Umbreit (Rubicon Water)

James Schneider (Olsson

Michael Archer (Nebraska Game and Parks)

Rodney Verhoeff (EA Engineering)

Scott Dicke (Central Nebraska Public Power and Irrigation District)

Summary of Meeting

1. Welcome and introductions – Sam Capps. The meeting started at 1:05 P.M. Attendees who signed in can be found on the sign-in sheet ("Sign-in Sheet," Attachment A).
    a. Nebraska Open Meetings Act requirements
        i. A copy of the Open Meetings Act was available both in-person and online.
    b. Review agenda and meeting objectives
        i. No changes or additions were made ("Agenda," Attachment B).
    c. Introductions
        i. Sixteen people attended in person and nine attended online.
2. Plan implementation progress – Sam Capps

    A draft of the annual report (*Sixth Annual Report for the Republican River Basin-Wide Plan* (Annual Report), Attachment C) was provided to participants. It was also available on the website (rrbwp.nebraska.gov). The purpose and location of each section of the report were provided as a reference.

    a. Annual Report: Plan Implementation Progress 2023 – Sam Capps
        i. Water supplies and uses in the basin (page 3 of Annual Report)
            1. Information on water supplies and uses in the Republican River Basin (Basin) can be found in the NRD, NeDNR, and Augmentation Pumping sections.
            2. No surface water management actions were required for Compact compliance in 2023. However, Kansas requested, and Nebraska provided their remaining Republican River Compact Call Volume (RCCV) for 2016.
            3. Next year (2025) will likely be a Compact Call Year.
        ii. Progress toward Goals, Objectives, and Action Items – Sam Capps
            1. Management activities (page 30 of Annual Report)
                a. Upper Republican NRD (URNRD) – Nate Jenkins
                    i. Nate Jenkins reported that 2023 was the first year of a new allocation period, with the allocation reduced to 62.5 inches per five-year timeframe, which is an average of 12.5 inches per year. This is close to the tipping point for deficit irrigation of corn. The district decertified 582 acres with the help of the State's Water Resources Cash Fund (WRCF). This was the highest stream depletion factor land the district has retired to

date. Soil moisture probes are being used on approximately 13,000 acres. The average water use was 11.75 inches in 2023, and groundwater declines were below the long-term annual average, at about 0.2 feet. The district is using a groundwater model to evaluate localized impacts of groundwater pumping on aquifer longevity given the variation of saturated aquifer thickness in the NRD.

b. Middle Republican NRD (MRNRD) – Jack Russell
    i. Jack Russell stated that the district sent a copy of the rules and regulations to every irrigator to ensure they clearly understand the rules. The district is approximately two-thirds of the way through its telemetry meter installation project. The district also conducted the second phase of a three-phase project using airborne electromagnetics (AEM) to develop modeling, which will help landowners with water management.

c. Lower Republican NRD (LRNRD) – Todd Siel
    i. Todd Siel reported that the district's average water use in 2023 was 7.69 inches. The district has installed approximately 500 telemetry flow meters and has received a grant to finish the project. There are approximately 3,000 flow meters in the district, with the goal of putting telemetry on 90-95% of the meters. There is concern about the water levels for irrigation supply in Harlan County Lake, which were trending ahead, but are now at levels similar to the previous year.

d. Tri-Basin NRD (TBNRD) – John Thorburn
    i. John Thorburn noted that 2023 was an average weather year, with drier conditions in the east. TBNRD's average water use was 7.69 inches. The district's Water Conservation Incentive Program (WCIP) is ongoing, with 1,970 acres enrolled; it is a voluntary allocation program in the Republican Basin portion of the district. The district signed an agreement with the NeDNR to access WRCF funding for remote reading meters and soil moisture sensors. The district is working with a company that has a ground-penetrating radar soil moisture sensor that can be mounted on center pivot systems. The district is working to maximize imported water from the Platte Basin through underground seepage; now that Elwood Reservoir has been repaired, it can hold more water for this purpose.

e. NeDNR – Sam Capps
    i. Sam Capps stated that the NeDNR supports Basin NRD projects by administering the WRCF. There are WRCF contracts with all the districts to provide cost share for decertification, telemetry, and soil moisture programs. The Department has WRCF contracts with irrigation districts to support their projects. NeDNR is also working on nitrogen reduction incentives and soil initiatives.

2. Measurable Hydrologic Objectives (MHOs) (page 65 of Annual Report) MHOs B and C are evaluated in the 5-Year Technical Analysis. MHOs A, D, and E are evaluated annually.
    a. For each MHO assessment, the report contains a description of the assessment and a table of results.
        i. MHO A (page 65 of Annual Report) – MHO A was achieved by all the Republican NRDs. TBNRD uses a 3-Year Net Average to establish a hydrologically balanced status, which TBNRD maintained in 2023.
        ii. MHO B and C (page 69 of Annual Report) – MHOs B and C were assessed as part of the first Five-Year Technical Analysis. MHO B was met by all NRDs; MHO C was on schedule but will require further analysis conducted by NeDNR and the NRDs
            1. The first MHO C screening occurred during the five-year review, using a Mann-Kendall test on observed wells to determine any statistically significant decline in groundwater levels. The next step (phase two) included a projection of groundwater levels through 2044. Wells that are projected to be at or below well depth by 2044 were flagged for NRD review. The NRDs will review the well observation data to determine if any wells should be removed from the analysis due to data anomalies or if declines do not indicate a potential limit to the availability of groundwater. The NRDs will then determine what information to provide to either confirm groundwater declines do not indicate a potential limit, or to propose areas to move into phase three. The NRDs will provide their feedback on the data at the next monthly meeting in December.

iii. MHO D (page 69 of Annual Report) – MHO D was achieved for 2023 in all the Republican NRDs. No portion of the rapid response area is part of the TBNRD.

iv. MHO E (page 70 of Annual Report) – Surface water was not administered in the URNRD, MRNRD, and LRNRD to ensure Compact compliance, MHO E was achieved.

b. Feasibility and Potential of Planned Projects – Various Stakeholders

i. Platte Republican Diversion Application – John Thorburn

1. The project is now nine years old. A water right for the diversion project had been applied for in 2018 and re-applied in 2019. There have been multiple hearings on the project. There was a hearing in May, and NeDNR gathered the information necessary to decide on the water right. The proposed water right, if approved, would always be junior to all other water rights.

ii. Nebraska Bostwick Irrigation District (NBID) Superior Canal Project – Sam Capps

1. The project is moving forward with land easements. The irrigation district hopes to begin construction next spring. The project is a diversion to give access to water to those impacted by shortfalls from Harlan County Lake.

iii. Natural Resources Conservation Service Watershed Protection and Flood Prevention Operations (NRCS WPFO) Projects for Lower Republican – Todd Siel

1. The Turkey Creek project was submitted to the NRCS national office, and comments are being reviewed. The Thompson Creek project will be submitted after the issues from Turkey Creek are resolved.
2. The Flag Creek augmentation project had two wells drilled and a pump test was conducted. Phase one was completed and revealed conveyance issues, which will need to be addressed.

c. Water Market Feasibility Study – Stefan Remund

i. A feasibility analysis has been completed and is available on the plan website. It was determined that a pilot project would not be pursued.

d. Drought Plan Update – Stefan Remund

i. A drought contingency plan is being developed with the NRDs. The plan includes a drought dashboard with Compact Call information,

gages, and general drought information. A communications component is being developed, with messaging around the Compact Call Year evaluation timeline and general drought information. The drought plan will include communication and coordination with emergency response, fire departments, emergency planners, NeDNR, and NRDs. A list of potential drought resiliency projects will be developed. The plan will also include a wish list of projects and initiatives to prevent or minimize damage caused by drought.

3. Collaboration
    a. Existing and potential new water conservation programs
        i. Capps reviewed existing decertification programs.
        ii. Brad Edgerton announced that the Frenchman-Cambridge Irrigation District has completed canal automation on the Meeker-Driftwood Canal and is operating it in Total Channel Control (TCC). Cambridge Canal has been operating in TCC for a number of years. There was no operation on the Meeker Canal in 2023 due to low reservoir levels. Red Willow Canal was not operated in 2023 but has been in use in 2024. The irrigation district is implementing software for water users to manage their accounts.

    b. Information sharing about water user management practice improvements
        i. Future opportunities to encourage and support water users to share information about management practice improvements – Sam Capps
            1. There were no comments from participants.
4. Conflicts Resulting from Implementation of the Plan, if any – Sam Capps (page 99 of *Republican River Basin-Wide Plan*)
    a. The Plan includes conflict resolution procedures for any conflicts resulting from the implementation of the Plan.
    b. No conflicts were submitted for consideration prior to this meeting.
5. Public comment
    a. An attendee thanked the Upper Republican NRD for lowering their water allocation. They also noted that some farmers are facing tough decisions about whether or not to plant based on cyclic availability of surface water. They also expressed concern that surface water users would shoulder most of the burden from Compact compliance measures.

Attachment A

2024 Annual Republican Basin-Wide Plan Annual Meeting

November 13, 2024 | Imperial, NE | 1:00 p.m. (MST)

SIGN-IN SHEET

Photos may be taken during this meeting. If you do not want your photo taken, please write your initials in the column labeled "No photo."

	Name:	Representing (Self or Organization):	No photo (initial)
1.	Nick Simonson	LRNRD	
2.	Nate Jenkins	URNRD	
3.	Sylvia Johnson	MRNRD	
4.	Alex Poyer	MRNRD	
5.	Jasper Fanning	URNRD	
6.	John Thorin	Tri-Basin NRD	
7.	Todd Sicl	LRNRD	
8.	Sam Capps	NeDNR	
9.	Stefan Remund	NeDNR	
10.	Kris Burgert	NeDNR	
11.	Elizabeth Esseks	NeDNR	
12.	David Brewster	USBR	
13.	Dale Cramer	FCID	
14.	Brad Edgerton	FCID	
15.	Chance Thayer	Self	
16.	(Nick Simonson)	(LRNRD)	
17.	(Jack Russell)	(MRNRD)	
18.			
19.			
20.			

Sixth Annual Meeting
Republican River Basin-Wide Plan

Wednesday, November 13, 2024
1:00 pm Mountain Time (2:00 pm Central Time)

Upper Republican Natural Resources District Office
511 E. 5th Street
Imperial, NE
Virtual participation option via Zoom

Agenda

1. Welcome and introductions
    a. Nebraska Open Meetings Act requirements
    b. Review agenda and meeting objectives
    c. Introductions
2. Plan implementation progress
    a. Annual Report: Plan Implementation Progress 2023
        i. Water supplies and uses in the basin
        ii. Progress toward goals and objectives of the plan
            1. Management activities
            2. Measurable Hydrologic Objectives (MHOs)
                a. MHO C, Phase 2 Update
    b. Feasibility and potential impacts of planned projects
    c. Water market feasibility study
    d. Drought plan update
3. Collaboration
    a. Existing and potential new water conservation programs
    b. Information sharing about water user management practice improvements
        i. Future opportunities to encourage and support water users to share information about management practice improvements
4. Conflicts Resulting from Implementation of the Plan, if any
    a. None submitted for consideration
5. Public comment

Attachment C

Sixth Annual Report for the Republican River Basin-Wide Plan

Data and Progress Updates, 2023

Presented at the Annual Meeting

November 13, 2024

Jointly prepared by
Upper Republican Natural Resources District
Middle Republican Natural Resources District
Lower Republican Natural Resources District
Tri-Basin Natural Resources District
&
Nebraska Department of Natural Resources

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Introduction

The *Republican River Basin-Wide Plan* (basin-wide plan) was developed by Nebraska Department of Natural Resources (NeDNR) and Upper Republican, Middle Republican, Lower Republican, and Tri-Basin Natural Resources Districts (NRDs), in consultation and collaboration with a Stakeholder Advisory Committee. The time frame to implement the basin-wide plan is approximately 25 years, spanning from the effective date of the basin-wide plan (March 1, 2019) to April 17, 2044, which is 30 years after the operative date of LB 1098 (2014), as specified in *Neb. Rev. Stat.* § 46-755.

Action Item 3.2.2 of the basin-wide plan specifies that NeDNR and the NRDs will annually exchange reports containing data and information about water supplies and uses in the Republican River Basin, management activities, and progress toward the goals and objectives of the basin-wide plan. This report contains the data and information about plan implementation progress for the 2023 calendar year, to be exchanged by NeDNR and the NRDs at the following year's annual meeting.

Water Supplies and Uses in the Basin

In accordance with the requirements of *Neb. Rev. Stat.* §§ 46-755 (5)(a) and 46-755 (5)(b), the basin-wide plan contains a monitoring plan, which includes a process to gather and evaluate data, information, and methodologies to increase understanding of the surface water and hydrologically connected groundwater system within the basin and to test the validity of the conclusions, information, and assumptions upon which the plan is based.

One component of the monitoring plan is a list of data on water supplies and uses in the Republican River Basin that will be reported annually by NeDNR and the NRDs (Table 3.1 of the basin-wide plan). As stated in the basin-wide plan's Monitoring section, it will take time for NeDNR and the NRDs to prepare each category of data for distribution; some of the listed data are readily available within existing data sets, while others will take significantly longer for methodology development. As a result, NeDNR and the NRDs will gradually increase the number of data items that will be reported on each year as they are able. In addition, as also noted in the plan, the list of data reported is subject to change as data needs and resources change over time.

This annual report contains data for the year 2023. The following data are included in this annual report:

Groundwater Levels and Observation Well Locations

The locations of wells used to monitor groundwater levels for all NRDs in the District are shown in Figure 1. Groundwater level data are provided to NeDNR by each NRD as part of the analysis of Measurable Hydrologic Objective (MHO) C for the basin-wide plan. Groundwater level data are available from the NRD upon request.

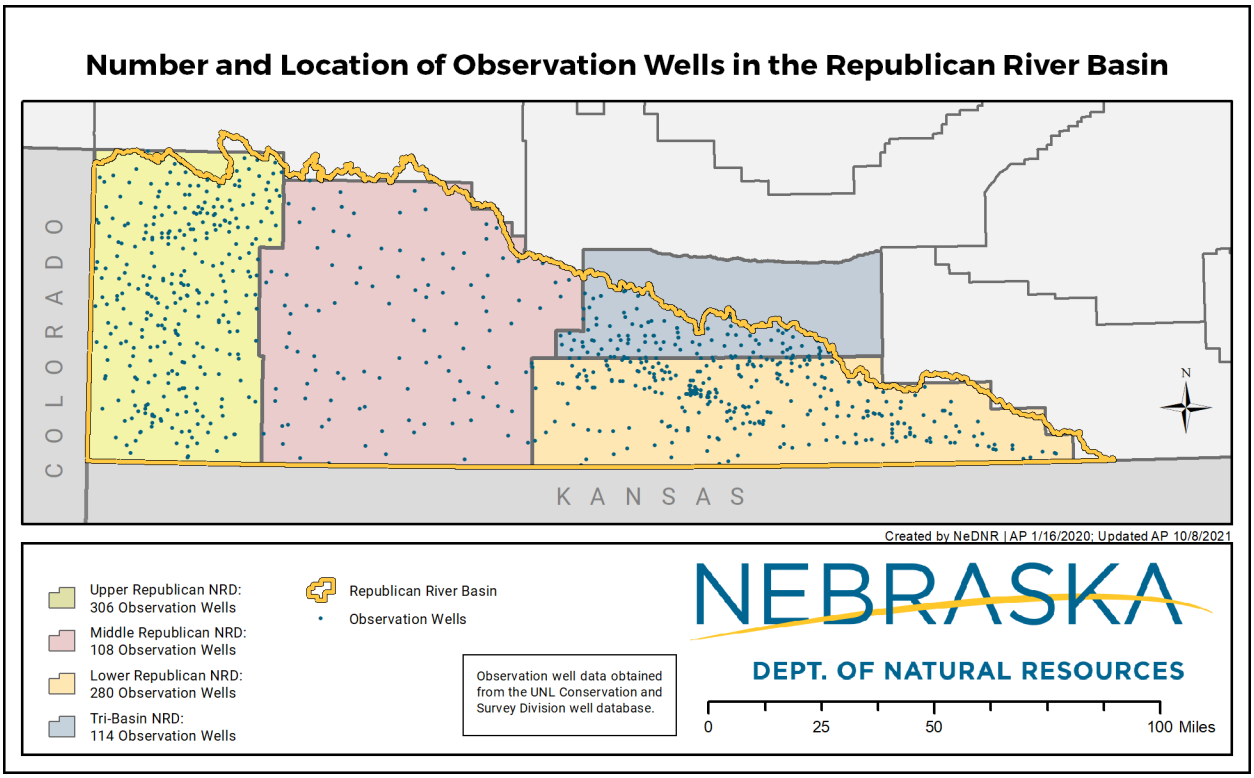

Figure 1. Location and number of groundwater observation wells within the Republican River Basin, by NRD, according to the University of Nebraska-Lincoln (UNL) Conservation and Survey Division well database.

Upper Republican Natural Resources District

Current Allocations

Upper Republican NRD's allocations and related rules for the 2023–2027 allocation period are summarized in Table 1. In this context, an allocation is a regulatory measure that stipulates the amount of water available to be used for irrigation.

Table 1. Summary of current allocation for groundwater irrigation use in Upper Republican NRD, 2023–2027 allocation period.

Total Allocation	62.5 Inches/Acre/5 Years
Annual or Base Allocation	Allocation is over 5 Years, not annual
Maximum Annual Use	62.5 Inches/Acre
Carry over amount that can be used in the following allocation period	7.5 Inches/Acre (Max)
Hard Cap	None
Pooling allowed?	Yes
How are the allocations affected by surface water use?	Allocations are not affected by surface water use. Irrigators may use their full groundwater allocation, regardless of any surface water use.
Special allocations for designated groundwater management areas? Or subbasins?	None
Rapid Response Area Allocations?	Rapid Response Area allocations will not be needed unless augmentation projects are insufficient to meet Republican River Compact obligations. Rapid Response Area allocations would depend upon projected Compact shortfalls.
Penalty for exceeding allocation	For every inch of excess use, 2 inches of allocation lost for next allocation period.
Penalty for exceeding carry over	2 inches carry-over deducted for every inch of carry-over used above 7.5 inches

Annual Groundwater Use for Irrigation

Annual groundwater use for irrigation in Upper Republican NRD, for 2023, is summarized in Table 2. This summary includes:

- The total number of certified acres within the district. For the purposes of this report, certified acres are those on which the NRD allows irrigation with groundwater.
- The total number of effective acres within the district. For the purposes of this report, effective acres are acres where groundwater irrigation was possible (i.e., certified acres minus acres enrolled in a conservation program prohibiting irrigation).
- The total volume of groundwater pumped for irrigation within the district.
- The average depth of water applied for irrigation on effective acres within the district.

Table 2. Annual groundwater use for irrigation in Upper Republican NRD, 2023. The difference between certified and effective acres is described in the body of the report.

Year	Certified Acres	Effective Acres	Volume Pumped (acre-feet)	Average Depth (inches/effective acre)
2023	429,920.1	429,920.1	420,951	11.75

Conservation and Irrigation Decertification Programs

Irrigation water cannot be used on acres enrolled in a permanent or temporary irrigation decertification program. Table 3 summarizes the number of acres within Upper Republican NRD that were enrolled in decertification programs in 2023. During 2023, decertification programs in effect in this NRD included the Conservation Reserve Enhancement Program (CREP) and a permanent irrigation decertification program jointly funded by Upper Republican NRD and the state of Nebraska's Water Resources Cash Fund (WRCF), which is administered by NeDNR. Contracts to decertify a total of 582.5 acres were signed in 2023. Approximately 454.5 of those acres were permanently decertified beginning in 2023; the remaining 128 acres are currently enrolled in CREP and will be permanently decertified when the CREP contract associated with them ends.

Table 3. Acres within Upper Republican NRD that will no longer be irrigated due to enrollment in a permanent or temporary decertification program. During 2023, decertification programs in effect in this NRD included CREP and the NRD's own decertification program, partially funded by the state's WRCF. *CREP data are as of September 30, 2023.

Year	Acres Enrolled in CREP*	Acres Enrolled in WRCF programs	Acres Enrolled in Other Decertification Programs
2023	8,205.1	3,378	0

Groundwater Levels and Observation Well Locations

The locations of wells used to monitor groundwater levels for all NRDs in the District are shown in Figure 1 (page 5). Groundwater level data are provided to NeDNR by this NRD as part of the analysis of MHO C for the basin-wide plan. A summary of the analysis is in the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report which was submitted to the legislature on February 29, 2024, and is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*. Groundwater level data are available from the NRD upon request.

Curtailment of Groundwater Pumping for Compact Compliance

Under the Integrated Management Plan (IMP) jointly developed by Upper Republican NRD and NeDNR, curtailment of groundwater pumping in an area called the "Rapid Response Area" may be required by the NRD if necessary for compliance with Nebraska's obligations under the Compact. During 2023, Upper Republican NRD did not curtail groundwater pumping in the Rapid Response Area for Compact compliance at any time.

Middle Republican Natural Resources District

Current Allocations

Middle Republican NRD's allocations and related rules for the 2023–2027 allocation period are summarized in Table 4. In this context, an allocation is a regulatory measure that stipulates the amount of water available to be used for irrigation.

Table 4. Summary of current allocations for groundwater irrigation use in Middle Republican NRD, 2023–2027 allocation period.

Total Allocation	60 Inches/Acre/5 Years
Annual or Base Allocation	12 Inches/Acre/Year
Maximum Annual Use	60 Inches/Acre (15 Inches/Acre in a Compact Call Year)
Carry over amount that can be used in the following allocation period	12 Inches/Acre (Max)
Hard Cap	15 Inches/Acre/Year
Pooling allowed?	Yes
How are the allocations affected by surface water use?	Allocations are not affected by surface water use. Irrigators may use their full groundwater allocation, regardless of any surface water use.
Special allocations for designated groundwater management areas? Or subbasins?	None
Rapid Response Area Allocations?	None
Allocation adjustment based on overuse	See explanation below*

***Middle Republican NRD Penalty for exceeding allocation:**

1.1 Allocation adjustments based on overuse, irrigation and acres

1.1.1 If an Owner or Operator has exceeded the Owner or Operator's base Groundwater Allocation, the Groundwater Allocation for the next Groundwater Allocation period shall be reduced by the number of acre inches, by which said Groundwater Allocation was exceeded in the prior period. Plus, an adjustment

of one (1) inch for every inch over the first three (3) inches and two (2) inches or every inch over three (3) inches of overuse will be applied. These allocation adjustments will be on top of what the producer has already used.

1.1.2 Overuse of the adjusted base allocation during a Compact Call Year shall result in a reduction of two (2) inches for every inch over the first three (3) inches and three (3) inches for every inch over three (3) inches of overuse will be applied. This adjustment will result in a correction to the remaining Groundwater Allocation following the Compact Call Year. This adjustment shall be in addition to the adjustments made by Rule 1.9.1 if the Compact Call Year is the last year of a Groundwater Allocation Period. These allocation adjustments will be on top of what the producer has already used.

Annual Groundwater Use for Irrigation

Annual groundwater use for irrigation in Middle Republican NRD, for 2023, is summarized in Table 5. This summary includes:

- The total number of certified acres within the district. For the purposes of this report, certified acres are those on which the NRD allows irrigation with groundwater.
- The total number of effective acres within the district. For the purposes of this report, effective acres are acres where groundwater irrigation was possible (i.e., certified acres minus acres enrolled in a conservation program prohibiting irrigation).
- The total volume of groundwater pumped for irrigation within the district.
- The average depth of water applied for irrigation on effective acres within the district.

Table 5. Annual groundwater use for irrigation in Middle Republican NRD, 2023. The difference between certified and effective acres is described in the body of the report.

Year	Certified Acres	Effective Acres	Volume Pumped (acre-feet)	Average Depth (inches/effective acre)
2023	298,156.97	284,460.67	284,555.43	10.22

Conservation and Irrigation Decertification Programs

Irrigation water cannot be used on acres enrolled in a permanent or temporary irrigation decertification program. Table 6 summarizes the number of acres within Middle Republican NRD that were enrolled in decertification programs in 2023. During 2023, decertification programs in effect in this NRD included CREP and a permanent irrigation decertification program jointly funded by Middle Republican NRD and the State's WRCF. In 2023, Middle Republican NRD entered into a contract with one landowner to permanently decertify 40 acres from groundwater irrigation and 20 acres from surface water irrigation.

Table 6. Acres within Middle Republican NRD that will no longer be irrigated due to enrollment in a permanent or temporary decertification program. During 2023, decertification programs in effect in this NRD included CREP and the NRD's own permanent decertification program, which is partially funded by the state's WRCF. *CREP data are as of September 30, 2023.

Year	Acres Enrolled in CREP *	Acres Enrolled in WRCF programs	Acres Enrolled in Other Decertification Programs
2023	14,024.3	60	0

Groundwater Levels and Observation Well Locations

The locations of wells used to monitor groundwater levels for all NRDs in the District are shown in Figure 1 (page 5). Groundwater level data are provided to NeDNR by this NRD as part of the analysis of MHO C for the basin-wide plan. A summary of the analysis is in the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report which was submitted to the legislature on February 29, 2024, and is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*. Groundwater level data are available from the NRD upon request.

Curtailment of Groundwater Pumping for Compact Compliance

Under the IMP jointly developed by Middle Republican NRD and NeDNR, curtailment of groundwater pumping in an area called the "Rapid Response Area" may be required by the NRD if necessary for compliance with Nebraska's obligations under the Compact. During 2023, Middle Republican NRD did not curtail groundwater pumping in the Rapid Response Area for Compact compliance at any time.

Lower Republican Natural Resources District

Current Allocations

Lower Republican NRD's allocations and related rules for the 2023–2027 allocation period are summarized in Table 7. In this context, an allocation is a regulatory measure that stipulates the amount of water available to be used for irrigation.

Table 7. Summary of current allocations for groundwater irrigation use in Lower Republican NRD, 2023–2027 allocation period.

Total Allocation	45 Inches/Acre/5 Years
Annual or Base Allocation	9 Inches/Acre/Year
Maximum Annual Use	45 Inches/Acre (13 Inches/Acre in a Compact Call Year)
Carry over amount that can be used in the following allocation period	9 Inches/Acre (Max)
Hard Cap	13 Inches/Acre/Year (in a Compact Call Year)
Pooling allowed?	Yes
How are the allocations affected by surface water use?	Allocations are not affected by surface water use. Irrigators may use their full groundwater allocation, regardless of any surface water use.
Special allocations for designated groundwater management areas? Or subbasins?	None
Rapid Response Area Allocations?	See explanation below**
Penalty for exceeding allocation	See penalty explanation below***
Penalty for exceeding carry over	See penalty explanation below***

****Lower Republican NRD Rapid Response Area Allocations:**

During Non-Compact Call years, the Rapid Response Area has the same Allocation as the rest of the District. During a Compact Call Year, the Allocation shall be set at the maximum allowable that would not cause the District's depletions to streamflow to exceed the District's allowable Ground Water depletions after taking into consideration other actions and controls that the District would implement. As set forth in the IMP, NeDNR will perform all calculations relating to the District's forecasted allowable Ground Water depletions, forecasted depletions, and potential yield from implementing actions and controls.

*****Lower Republican NRD Rule 3-2 Penalties:**

3-2.1. Unless otherwise provided, imposition of penalties shall be at the discretion of the Board and may include, but are not limited to:

(a) A reduction (in whole or in part) of a Person's Allocation of Ground Water;
(b) A reduction (in whole or in part) of a Person's Certified Irrigated Acres; and
(c) Decommissioning of Water Wells.

3-2.2. Where penalties are enumerated in the Rules and Regulations, the Board may impose additional penalties, up to and including a permanent forfeiture of Certified Irrigated Acres, and/or a permanent forfeiture of all future Allocations, under the following circumstances: (1) previous violations of any Rule or Regulation, (2) multiple violations of these Rules and Regulations, (3) engaging in willful and wanton misconduct, or (4) certification by the record owner to the District of the non-irrigation status of certain Certified Irrigated Acres in order to opt-out of an Occupation Tax levied by the District, which status is later found to be false in whole or in part.

3-2.3. Any Person who violates a cease and desist order issued by the District pursuant to *Neb. Rev. Stat.* § 46-707(h) may be subject to a civil penalty assessed pursuant to *Neb. Rev. Stat.* § 46-745.

Annual Groundwater Use for Irrigation

Annual groundwater use for irrigation in Lower Republican NRD, for 2023, is summarized in Table 8. This summary includes:

- The total number of certified acres within the district. For the purposes of this report, certified acres are those on which the NRD allows irrigation with groundwater.
- The total number of effective acres within the district. For the purposes of this report, effective acres are acres where groundwater irrigation was possible (i.e., certified acres minus acres enrolled in a conservation program prohibiting irrigation).
- The total volume of groundwater pumped for irrigation within the district.
- The average depth of water applied for irrigation on effective acres within the district.

Table 8. Annual groundwater use for irrigation in Lower Republican NRD, 2023. The difference between certified and effective acres is described in the body of the report.

Year	Certified Acres	Effective Acres	Volume Pumped (acre-feet)	Average Depth (inches/effective acre)
2023	318,927.16	310,493.17	199,015.48	7.69

Conservation and Irrigation Decertification Programs

Irrigation water cannot be used on acres enrolled in permanent or temporary irrigation decertification program. Table 9 summarizes the number of acres within Lower Republican NRD that were enrolled in decertification programs in 2023. During 2023, decertification programs in effect in this NRD included CREP.

Table 9. Acres within Lower Republican NRD that will no longer be irrigated due to enrollment in a permanent or temporary decertification program. During 2023, decertification programs in effect in this NRD included CREP and other decertification programs. *CREP data are as of September 30, 2023.

Year	Acres Enrolled in CREP *	Acres Enrolled in WRCF programs	Acres Enrolled in Other Decertification Programs
2023	6,556.4	0	2,651.43

Groundwater Levels and Observation Well Locations

The locations of wells used to monitor groundwater levels for all NRDs in the District are shown in Figure 1 (page 5). Groundwater level data are provided to NeDNR by this NRD as part of the analysis of MHO C for the basin-wide plan. A summary of the analysis is in the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report which was submitted to the legislature on February 29, 2024, and is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*. Groundwater level data are available from the NRD upon request.

Curtailment of Groundwater Pumping for Compact Compliance

Under the IMP jointly developed by Lower Republican NRD and NeDNR, curtailment of groundwater pumping in an area called the "Rapid Response Area" may be required by the NRD if necessary for compliance with Nebraska's obligations under the Compact. During 2023, Lower Republican NRD did not curtail groundwater pumping in the Rapid Response Area for Compact compliance at any time.

Tri-Basin Natural Resources District

Current Allocations

Tri-Basin NRD's allocations and related rules for the 2023-2025 allocation period are summarized in Table 10. In this context, an allocation is a regulatory measure that stipulates the amount of water available to be used for irrigation.

Table 10. Summary of current allocations for groundwater irrigation use in the Tri-Basin NRD, 2023-2025 allocation period.

Total Allocation	27 Inches/Acre/3 Years
Annual or Base Allocation	9 Inches/Acre/Year
Maximum Annual Use	27 Inches/Acre
Carry over amount that can be used in the following allocation period	9 Inches/Acre (Max)
Hard Cap	None
Pooling allowed?	Yes
How are the allocations affected by surface water use?	Allocations are not affected by surface water use. Irrigators may use their full groundwater allocation, regardless of any surface water use.
Special allocations for designated groundwater management areas? Or subbasins?	Allocation only required in Phase 3 groundwater quantity management areas. Current Phase 3 area is Township 5 North, Range 22 West (Union Twp.) in Gosper County.
Rapid Response Area Allocations?	None
Penalty for exceeding allocation	1.5 times the overuse amount
Penalty for exceeding carry over	1.5 times the overuse amount

Annual Groundwater Use for Irrigation

Annual groundwater use for irrigation in Tri-Basin NRD, for 2023, is summarized in Table 11. This summary includes:

- The total number of certified acres within the district. For the purposes of this report, certified acres are those on which the NRD allows irrigation with groundwater.
- The total number of effective acres within the district. For the purposes of this report, effective acres are acres where groundwater irrigation was possible (i.e., certified acres) and on which irrigators reported applying water. Certified irrigated acres enrolled in a conservation program prohibiting irrigation were deducted from the total of effective acres.
- The total volume of groundwater pumped for irrigation (including pumping for wetland habitat by US Fish and Wildlife Service and Nebraska Game and Parks Commission) within the district.
- The average depth of water applied for irrigation on effective acres within the district.

Table 11. Annual groundwater use for irrigation in the Republican River Basin portion of Tri-Basin NRD, 2023. The difference between certified and effective acres is described in the body of the report.

Year	Certified Acres	Effective Acres	Volume Pumped (acre-feet)	Average Depth (inches/effective acre)
2023	190,104.91	177,966.98	146,246.117	9.86

Conservation and Irrigation Decertification Programs

Irrigation water cannot be used on acres enrolled in a permanent or temporary irrigation decertification program. Table 12 summarizes the number of acres within the Republican River Basin portion of Tri-Basin NRD that were enrolled in decertification programs in 2023. During 2023, the decertification program in effect in the Republican River Basin portion of this NRD included CREP.

Table 12. Acres within the Republican River Basin portion of Tri-Basin NRD that will no longer be irrigated due to enrollment in a permanent or temporary decertification program. During 2023, the decertification program in effect in this NRD included CREP. *CREP data are as of September 30, 2023.

Year	Acres Enrolled in CREP *	Acres Enrolled in WRCF programs	Acres Enrolled in Other Decertification Programs
2023	1,626.1	0	33.2

Tri-Basin NRD Water Conservation Incentive Program (WCIP) is intended to address two natural resources management issues: ensuring sustainability of groundwater supplies and protecting streamflows from diminishment due to groundwater pumping. The goal of this voluntary program is to reduce groundwater pumping and increase irrigation water use efficiency in Tri-Basin NRD. Acres enrolled in the WCIP program in 2023 are listed in Table 13.

Tri-Basin will allow landowners to enroll up to 8000 NRD-certified irrigated acres in the program. Any parcel enrolled is subject to a voluntary five-year allocation of groundwater pumping for irrigation. The allocation is equivalent to the average corn irrigation requirement, as determined by the University of

Nebraska-Lincoln (UNL). Once the enrollment limit is reached, water savings to the district are expected to reach at least 650 acre-feet per year. Incentives in this program will likely be most attractive to landowners in phase two and phase three groundwater quantity management areas, so the water-use reductions should be greatest where the need is greatest (there are approximately 30,000 certified irrigated acres in Tri-Basin NRD's phase two and phase three townships).

In exchange for their participation, if landowners use less than their full allocation, they will be paid for the equivalent of one acre-inch of water credit per acre per year, with the opportunity to sell additional unused credits to the NRD at a set price. In addition to NRD purchases, landowners will have the opportunity to sell water credits on the open market at any agreed-upon price (private transactions require NRD board approval). Landowners will also be granted flexibility to irrigate any acres within enrolled parcels and to share (pool) allocations between parcels. Pooling agreements will be required to enable sharing allocations between parcels under different ownership.

Table 13. Acres in the Republican River Basin enrolled in the Tri-Basin NRD's WCIP in 2023. The "New Acres Enrolled" column indicates the number of acres that were added to the program in the year indicated. The "Total Acres Enrolled" column indicates the total number of acres enrolled as of the year indicated.

Year	New Acres Enrolled	Total Acres Enrolled
2023	402.36	1,970.05

Groundwater Levels and Observation Well Locations

The locations of wells used to monitor groundwater levels for all NRDs in the District are shown in Figure 1 (page 5). Groundwater level data are provided to NeDNR by this NRD as part of the analysis of MHO C for the basin-wide plan. A summary of the analysis is in the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report which was submitted to the legislature on February 29, 2024, and is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*. Groundwater level data are available from the NRD upon request.

Nebraska Department of Natural Resources

The Republican River Basin is located at the intersection of Nebraska, Colorado, and Kansas (Table 14 and Figure 2). The Compact, administered by the Republican River Compact Administration (RRCA) is an interstate agreement that allocates consumption of the waters of the Republican River Basin among the three states. Unless otherwise indicated, the data reported in the NeDNR section of this report are from the RRCA's approved accounting data, data Nebraska provided to Colorado and Kansas as part of the RRCA's annual data exchange, or calculations using the RRCA groundwater model.

Table 14. Area of Nebraska, Kansas, and Colorado within the Republican River Basin (United States Geological Survey (USGS) Hydrologic Unit Code: 102500).

State	Republican River Basin Area (mi^2)
Colorado	7,816
Kansas	7,551
Nebraska	9,546

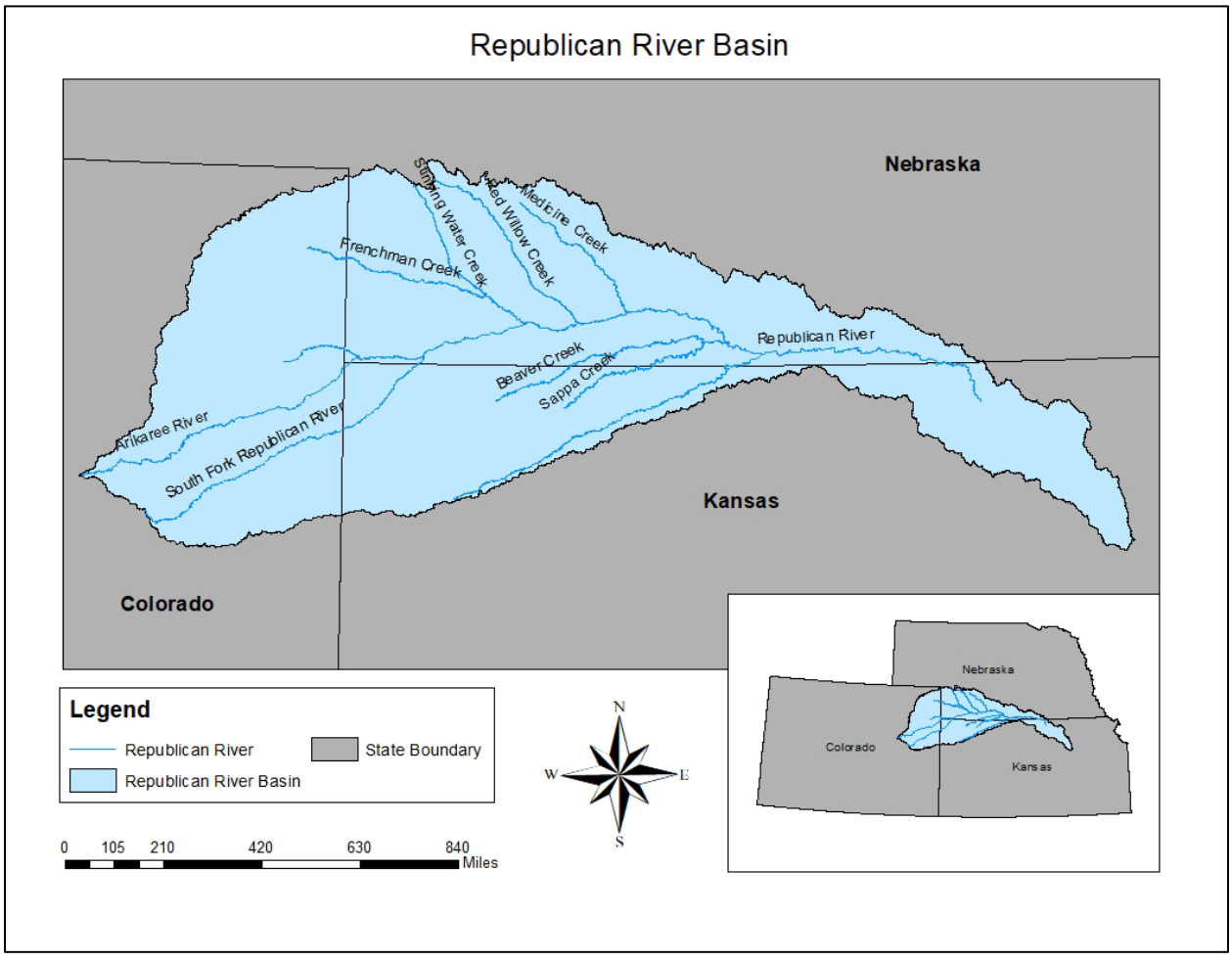

Figure 2. Extent of Republican River Basin within Nebraska, Kansas, and Colorado (USGS Hydrologic Unit Code: 102500).

Precipitation

Annual precipitation data used in RRCA analyses is measured at National Weather Service cooperative stations across the Republican River Basin in Nebraska, quality-controlled, and filled in with PRISM (Parameter-Elevation Regressions on Independent Slopes Model) data by the RRCA, as necessary. In 2023, annual precipitation data used in RRCA analyses ranged from 18.15 inches to 29.48 inches. Figure 3 displays 2023 precipitation data at each of the cooperative stations used by the RRCA; additional stations outside of Nebraska and the basin are used by the RRCA to interpolate precipitation across the whole RRCA model area which extends beyond the basin boundary.

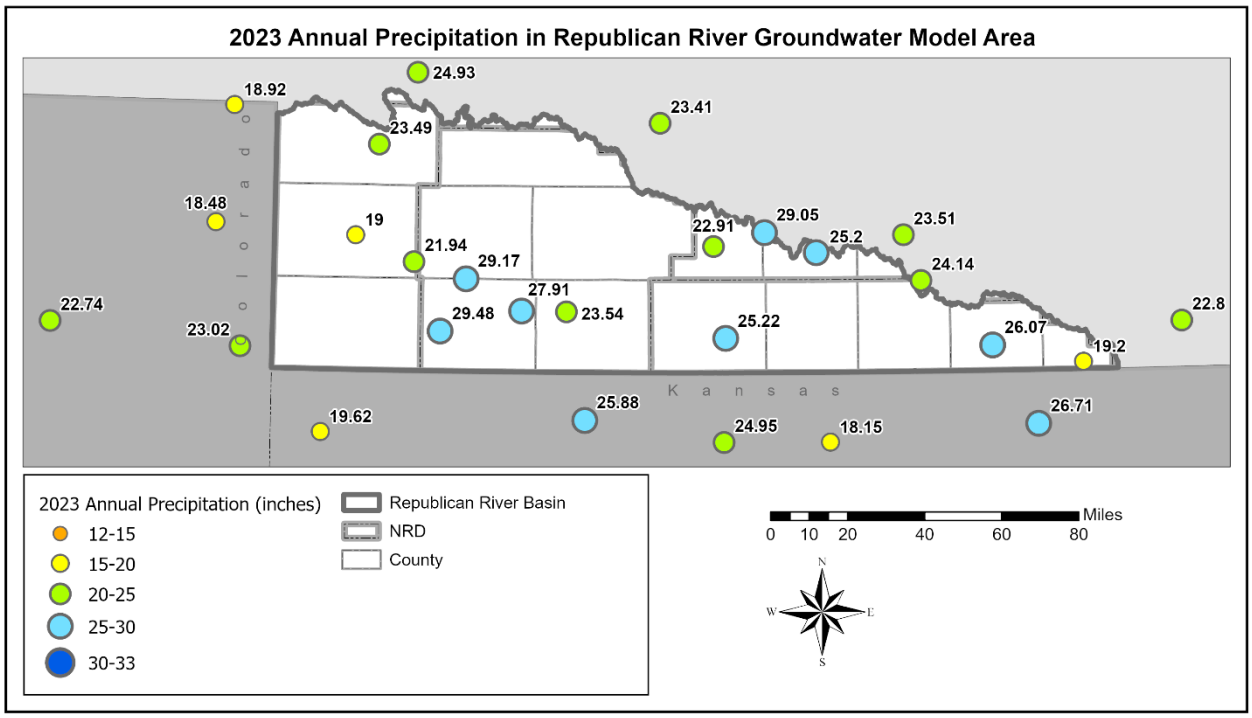

Figure 3. 2023 annual precipitation in inches from National Weather Service cooperative stations, as used in RRCA groundwater model processing.

Streamflow

Under the Republican River Compact, allocations within each Republican River subbasin include the streamflow at the downstream end of the subbasin. Subbasin streamflow is measured for the Compact by 13 USGS streamgages and one NeDNR streamgage (Figure 4 and Table 15). The most downstream streamgages in Nebraska are on the Main Stem of the Republican River at Guide Rock and Hardy. Table 15 presents the total amount of water in acre-feet measured past each of the streamgages in 2023. For more details and to obtain continuous stream and reservoir, partial year, canal, canal return flow, and miscellaneous spot measurement data from over 250 gaging sites visit the NeDNR website: *https://nednr.nebraska.gov/RealTime/*.

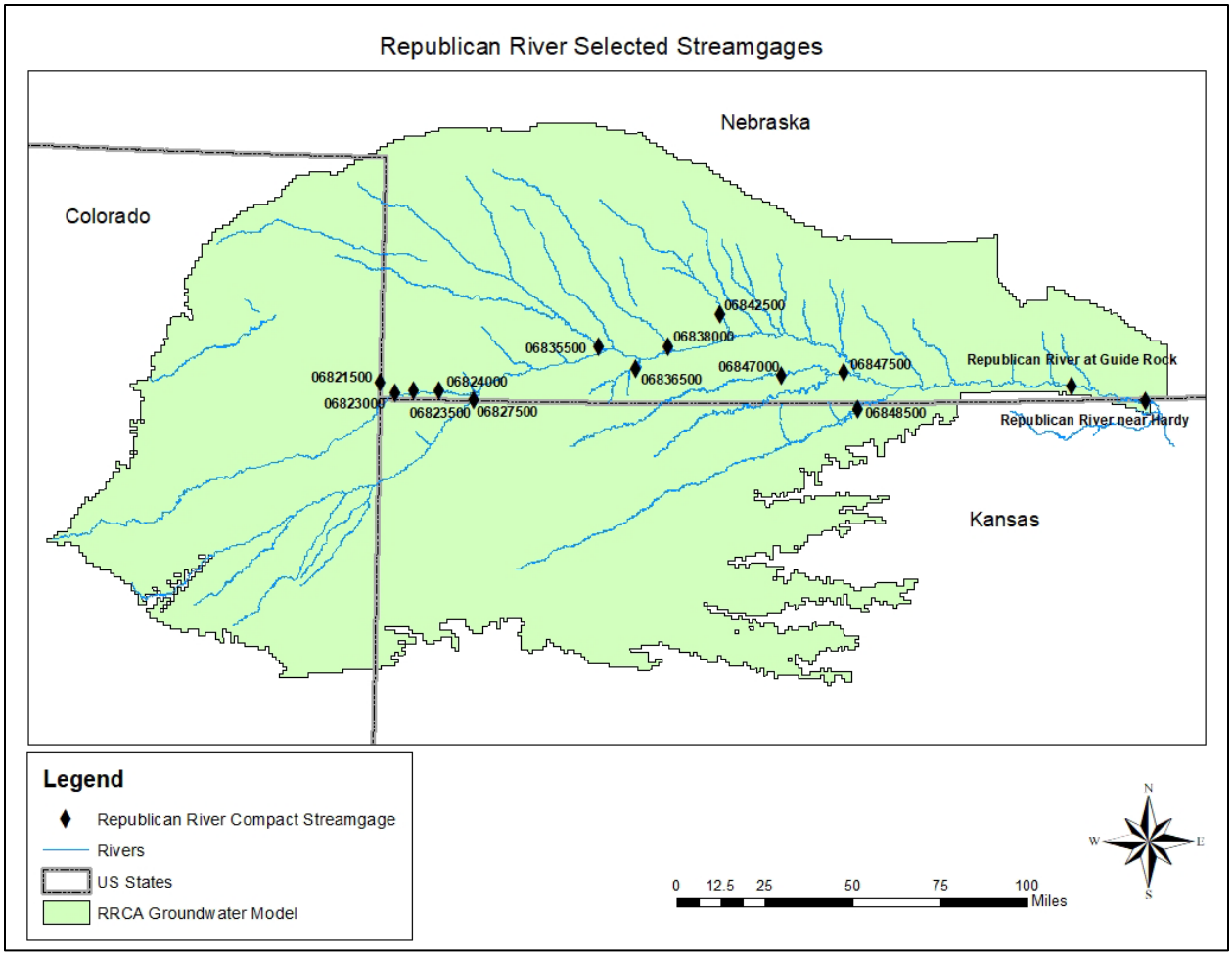

Figure 4. Location of subbasin streamgages within the Republican River Basin.

Table 15. Annual streamflow volumes in acre-feet from Republican River subbasin streamgages used in the Republican River Compact accounting.

Annual Streamflow (acre-feet)	
Streamgage	**2023**
USGS 06823000 - North Fork of the Republican River at Colorado-Nebraska State Line	28,618
USGS 06821500 - Arikaree River at Haigler	1,678
USGS 06823500 - Buffalo Creek near Haigler	1,601
USGS 06824000 - Rock Creek at Parks	3,963
USGS 06827500 - South Fork Republican River near Benkelman	48
USGS 06835500 - Frenchman Creek at Culbertson	30,628
USGS 06836500 - Driftwood Creek near McCook	7,130
USGS 06838000 - Red Willow Creek near Red Willow	4,653
NeDNR 06842500 - Medicine Creek below Harry Strunk Lake	17,440
USGS 06847000 - Beaver Creek near Beaver City	648
USGS 06847500 - Sappa Creek near Stamford	4,923
USGS 06848500 - Prairie Dog Creek near Woodruff, Kansas	4,178
USGS 06853020 - Republican River at Guide Rock	14,677
USGS 06853500 - Republican River near Hardy	34,861

Irrigated Acres

For the Republican River Compact Administration Groundwater Model, Nebraska currently reports irrigated acres as one of the following:

1. Groundwater-only irrigated acres.
2. Surface water-only irrigated acres or surface water and groundwater (commingled) irrigated acres.

Acres irrigated with groundwater are reported with metered pumping annually by the NRDs to NeDNR or are estimated for the portions of the RRCA model area that are in NRDs without metered pumping. Acres irrigated with surface water and commingled water are flagged annually based on use from a master database developed from water right information. Annual irrigated acres within the RRCA model from 2023 have been divided into the two reporting methods and groundwater acres have been delineated by the NRD that the model cells primarily overlay (Figure 5). Nebraska annual total surface water and commingled, and groundwater irrigated acres are also presented in Table 16. The groundwater-irrigated acres shown in Figure 5 and Table 16 for Tri-Basin NRD include acres that are in the Platte, Little Blue, and Republican River Basins because all of Tri-Basin NRD is included in the RRCA groundwater model area.

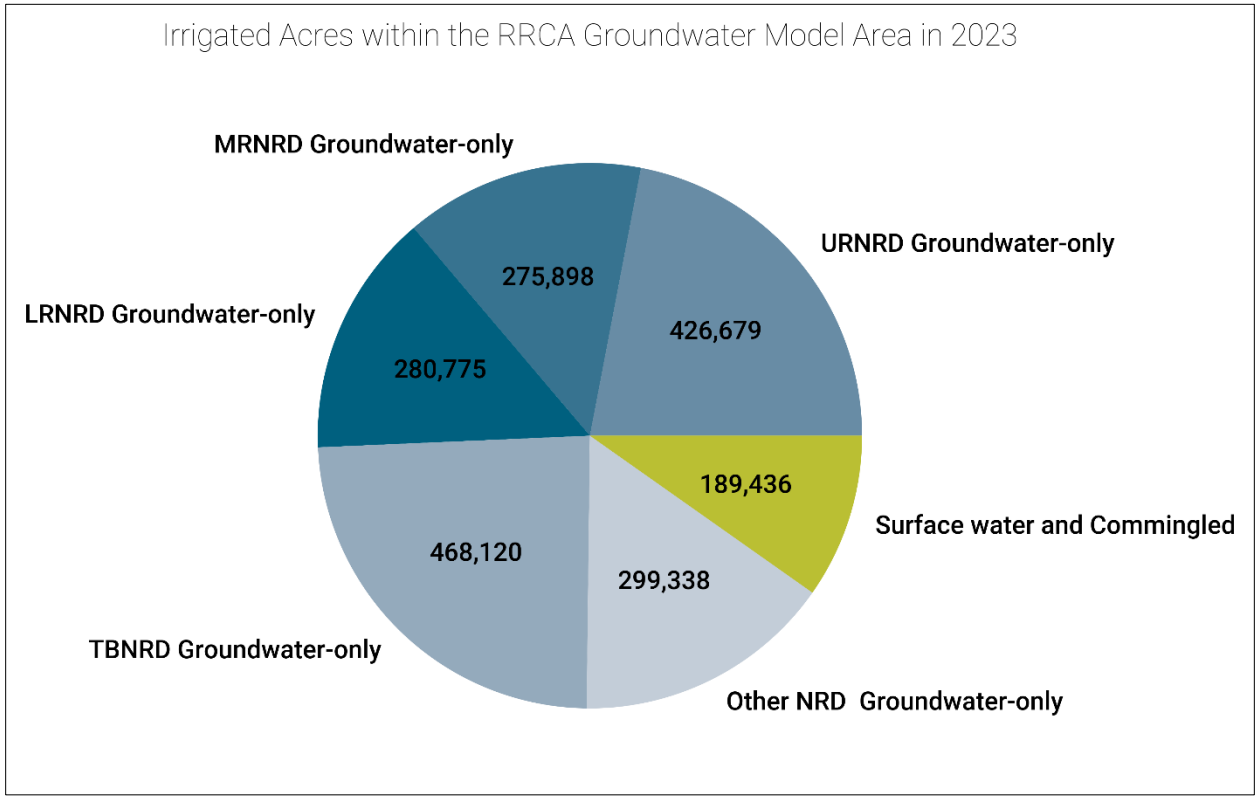

Figure 5. Irrigated Acres within the RRCA Groundwater Model Area in 2023.

Table 16. Annual division of acres irrigated by surface water and commingled, or acres irrigated by only groundwater in the Nebraska portion of the RRCA groundwater model.

Area and Irrigation Type	2023
Nebraska Model Area – Surface Water and Commingled	189,436
Upper Republican NRD – Groundwater-only	426,679
Middle Republican NRD – Groundwater-only	275,898
Lower Republican NRD – Groundwater-only	280,775
Tri-Basin NRD – Groundwater-only	468,120
Other – Groundwater-only	299,338

Allocation and Computed Beneficial Consumptive Use (CBCU)

Under the Republican River Compact, the total water supply and how much of the total supply each state is entitled to beneficially use is referred to as "allocation." The allocations are calculated from the water supply of the basin if it had been undepleted by the activities of man. Each state is allotted a fixed percentage of the undepleted water supply in each of the Republican River subbasins to obtain the states' allocations. The calculated uses of the water supplies are referred to as "Computed Beneficial Consumptive Use" (CBCU). The CBCU in the Republican River Basin includes direct surface water uses, such as reservoir evaporation and consumption of diverted water, and withdrawal or interception of streamflow by groundwater pumping (groundwater depletions to streamflow). Groundwater pumping can have a lagged effect on streamflow. The RRCA groundwater model considers the effects of pumping since early well development in the 1940s, therefore, the groundwater consumptive use of streamflow in each year is impacted by pumping in that year and all previous years. Table 17 presents total CBCU in Colorado, total CBCU in Kansas, and the breakdown of total CBCU as surface water or groundwater CBCU from Nebraska.

Nebraska groundwater CBCU are presented for the effects of pumping from each NRD's portion of the basin separately (Upper Republican, Middle Republican, Lower Republican, and Tri-Basin NRDs) and all other NRDs within the model area collectively (Other NRD) in Table 17. Each NRD's groundwater CBCU is equivalent to the net depletions to streamflow due to groundwater pumping within that NRD.

Table 17. Annual total CBCU by Kansas and Colorado and annual Nebraska total surface water CBCU and division of groundwater CBCU (i.e., net depletions to streamflow) by each NRD. The sum of Nebraska CBCU presented in this table may vary slightly from the statewide CBCU in Nebraska's Compact compliance tables due to rounding.

CBCU (acre-feet)	
	2023
Colorado	38,420
Kansas	62,370
Nebraska Surface Water	43,078
Lower Republican NRD Groundwater	51,369
Middle Republican NRD Groundwater	57,439
Upper Republican NRD Groundwater	79,891
Tri-Basin NRD Groundwater	13,013
Other NRD Groundwater	2,781

Reservoir Storage and Evaporation

Federal Reservoir Storage

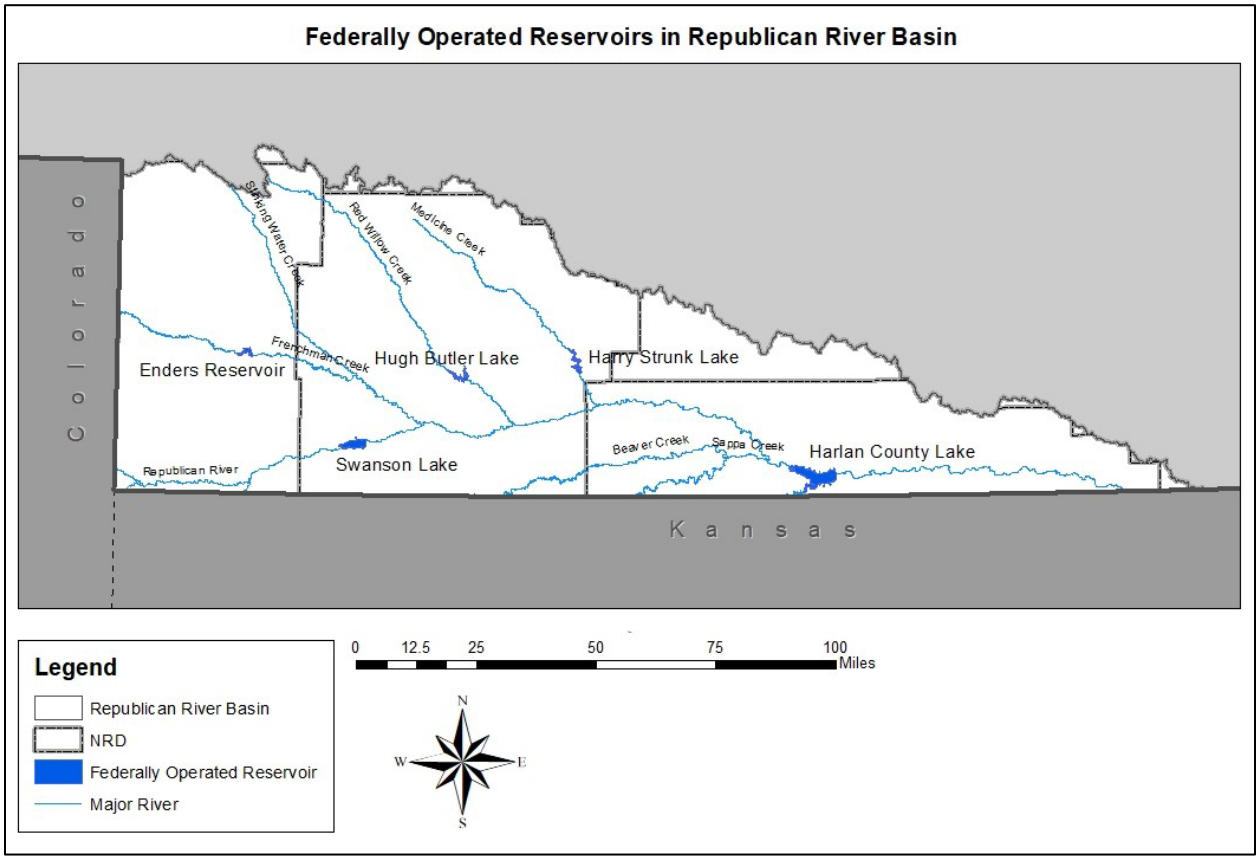

Figure 6. Location of federal reservoirs located in Nebraska portion of the Republican River Basin.

There are five federally operated reservoirs within the Republican River Basin in Nebraska: Enders Reservoir on Frenchman Creek, Hugh Butler Reservoir on Red Willow Creek, Harry Strunk Reservoir on Medicine Creek, and Swanson Lake and Harlan County Lake on the Republican River (Figure 6). Annual end of year storage volumes for 2023 for each Republican River Basin reservoir in Nebraska are shown in Figure 7. Storage data were obtained from the United States Bureau of Reclamation (USBR), which are available on the USBR's automated data system HydroMet at *https://www.usbr.gov/gp/hydromet/*.

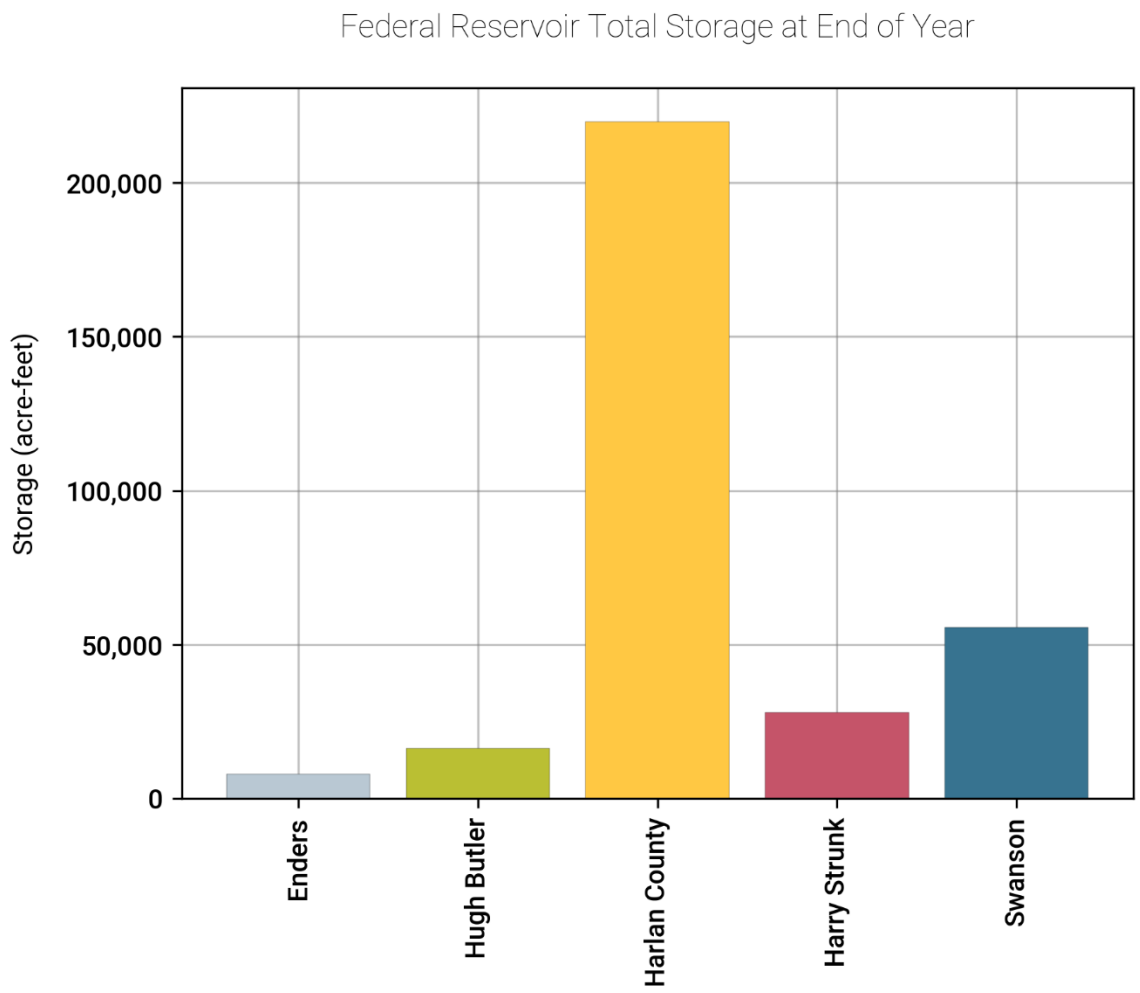

Figure 7. 2023 end-of-year reservoir contents for the federally operated reservoirs within the Republican River Basin in Nebraska: Enders Reservoir on Frenchman Creek, Hugh Butler Reservoir on Red Willow Creek, Harry Strunk Reservoir on Medicine Creek, and Swanson Lake and Harlan County Lake on the Republican River.

Reservoir Evaporation

Net evaporation from Republican River Basin reservoirs in Nebraska in 2023 was 17,042 acre-feet from the five federal reservoirs and 1,322 acre-feet from non-federal reservoirs. Federal and non-federal reservoir evaporation are beneficial consumptive uses of surface water. For the RRCA, federal and non-federal reservoir CBCU are calculated as net evaporation, which is evaporation from the reservoir minus precipitation directly intercepted by the reservoir.

Surface Water Municipal and Industrial CBCU

During the reporting year, there were no permitted municipal nor industrial uses of surface water in the Republican River Basin. For more information on surface water permitting, visit NeDNR's Surface Water Permitting and Data website at: *https://dnr.nebraska.gov/surface-water*.

Surface Water Administration for Compact Compliance

Under the IMPs jointly developed by NeDNR and Upper Republican, Middle Republican, and Lower Republican NRDs, NeDNR may administer and regulate surface water, if necessary, to ensure compliance with Nebraska's obligations under the Compact during Compact Call Years. Compact Call Years are years in which NeDNR's analysis following the forecast procedures contained in the IMPs for Upper Republican, Middle Republican, and Lower Republican NRDs indicate the potential for noncompliance with the Compact if sufficient management actions are not taken. 2023 was a Compact Call Year.

In October 2023, Kansas requested administration of 1,860 acre-feet of Remaining Compact Compliance Volume (RCCV) from 2016. The water was administered into the Kansas irrigation supply in Harlan County Lake in late 2023 during the non-irrigation season. The RCCV balance was zero at the end of 2023. MHO E was achieved in 2023 because surface water was not administered for Compact Compliance (no irrigators were shut down during irrigation season), and the RCCV was water generated through NRD management actions.

Surface water is also administered under the Water-Short Year provisions of the Final Settlement Stipulation (FSS) for the Compact. This type of water administration is triggered automatically under the terms of the FSS: whenever the projected or actual irrigation supply available in Harlan County Lake is less than 130,000 acre-feet and water is needed for direct diversion at Guide Rock, Nebraska must close appropriations downstream of Harlan County Lake that are junior to February 26, 1948. Because this type of water administration is triggered automatically, it is not considered a management action for the purposes of evaluating the basin-wide plan's MHO E.

Qualitative Evaluation of Net Effect of Management Actions for Compact Compliance

Action Item 1.2.1 of the basin-wide plan is to qualitatively evaluate the net effect on water supplies of any management actions that are taken for Compact compliance. As described in the previous subsection, "Surface Water Administration for Compact Compliance," and in the subsection titled "Curtailment of Groundwater Pumping for Compact Compliance" within each NRD's section for reporting water supplies and uses (pages 8, 11, 14), neither surface water administration nor curtailment of groundwater pumping occurred in 2023. In addition, as stated in the progress summary for Action Item 1.1.2 (page 39) no management actions were necessary as offsets in 2023.

Some actions were taken in 2023 that will help with Compact compliance in future years. NeDNR and all four NRDs worked to enroll or reenroll landowners in temporary or permanent irrigation decertification programs (pages 7, 10, 14, and 16). Upper Republican, Middle Republican, and Lower Republican NRDs specify district-wide allocations on groundwater usage (pages 6, 9, and 12). Tri-Basin NRD specifies allocations on groundwater usage within Phase 3 groundwater quantity management areas (page 15), and other landowners within Tri-Basin NRD are enrolled in their Water Conservation Incentive Program (WCIP) to incentivize water conservation (page 16). Both decertification programs and allocation programs are expected to have a positive effect on water supplies by reducing consumptive use of water.

See the text explaining administration of RCCV in Surface Water Administration for Compact Compliance (above).

Augmentation Pumping

This section contains a summary of pumping data for the augmentation projects in the basin.

NeDNR annually evaluates the net impacts of augmentation pumping for the Nebraska Cooperative Republican Platte Enhancement project (N-CORPE) and Rock Creek Augmentation projects, to fulfill a requirement of the IMPs jointly developed by NeDNR and Upper Republican, Middle Republican, and Lower Republican NRDs. The IMPs state that "…NeDNR will annually evaluate whether offsets are necessary to mitigate new net depletions resulting from augmentation pumping or other management actions." The most recent analysis is available in the report *Net Impacts Analysis for the Republican River Basin* (November 13, 2024), which is available on NeDNR's website (*https://dnr.nebraska.gov*).

N-CORPE Augmentation Project

The N-CORPE Augmentation Project is operated through an interlocal cooperative agreement formed in 2012 by Upper Republican NRD, Middle Republican NRD, Lower Republican NRD, and Twin Platte NRD. A summary of N-CORPE pumping for 2023 is provided in Table 18.

Table 18. Summary of N-CORPE Augmentation Project pumping. The "Days Pumped for Compact Compliance" column indicates the number of days the project was pumped to augment streamflow for Republican River Compact compliance purposes. The "Total Pumped Volume" column provides the volume of water pumped in that year for all other purposes, including augmentation for the Platte Basin and maintenance pumping.

Year	Days Pumped for Compact Compliance	Volume Pumped for Compact Compliance (acre-feet)	Total Pumped Volume (acre-feet)
2023	0	n/a	3203.54

Rock Creek Augmentation Project

The Rock Creek augmentation project is operated by Upper Republican NRD. A summary of Rock Creek augmentation project pumping for 2023 is provided in Table 19.

Table 19. Summary of Rock Creek augmentation project pumping. The "Days Pumped for Compact Compliance" column indicates the number of days the project was pumped to augment streamflow for Compact compliance purposes. The "Total Pumped Volume" column provides the volume of water pumped in that year for all other purposes, including augmentation and maintenance pumping.

Year	Days Pumped for Compact Compliance	Volume Pumped for Compact Compliance (acre-feet)	Total Pumped Volume (acre-feet)
2023	0	n/a	58.41

Turkey Creek Augmentation Well

The Turkey Creek augmentation well is operated by Tri-Basin NRD as part of the NRD's Republican Basin Streamflow Augmentation Project. Since construction was completed in 2016, this well has not been operated for augmentation purposes.

Figure 8. Headwaters of Turkey Creek, Gosper County; courtesy of Tri-Basin NRD.

Progress toward Goals, Objectives, and Action Items

Progress toward the basin-wide plan's goals, objectives, and action items is described below, in two subsections. The "Management Activities" subsection summarizes progress toward the plan's goals, objectives, and action items. The "Assessment of Measurable Hydrologic Objectives (MHOs)" subsection contains the results of the MHO assessments used to evaluate overall plan progress. Specific progress report details can be found on the following pages:

Management Activities

Under *Neb. Rev. Stat.* § 46-755 (4), the basin-wide plan was required to include a timeline of up to 30 years after April 17, 2014, to meet the plan's goals and objectives. The basin-wide plan took effect on March 1, 2019. This section summarizes progress toward the basin-wide plan's goals, objectives, and action items during the 2023 calendar year, first as a visual snapshot of overall plan progress (beginning on page 32) followed by summaries describing progress on individual action items (beginning on page 39).

Two icons are displayed beside each action item in both the visual progress snapshot and the progress summaries. One symbol indicates when the action item is to be completed, according to the implementation schedule in the basin-wide plan. The other symbol indicates progress made on that action item during 2023. Figure 9 is a key describing the meanings of the symbols used throughout the "Management Activities" section.

Republican River Basin-Wide Plan Progress Summary Key

Symbols indicating when action item is to be completed, per plan schedule

When Appropriate	Annually	Annually When Appropriate	By This Year	Every Five Years
				
To be completed when beneficial, feasible, and economically viable; at NeDNR and NRDs' discretion	To be completed every year	To be completed in every year that the triggering circumstances described in the plan occur	To be completed by a certain year; likely can be "completed indefinitely"	To be completed every five years, either corresponding with the five-year analysis or in the following year, as specified in the basin-wide plan

Symbols indicating progress during report year

Completed Indefinitely	Completed	Ongoing Progress	Not Completed	Not Started	Not Applicable This Year
					N/A
Fully complete and no longer able to be worked on in the future	Recurring task completed during report year	Work on this action item is ongoing, generally progressing	Not completed as planned during report year	Not started as planned during report year	Did not need to be completed during report year

Figure 9. Key to symbols used throughout the "Management Activities" section. The report year for this report is 2023.

Progress Snapshot

This section contains a snapshot of overall progress on the basin-wide plan's goals and objectives. Visual summaries of progress on each goal can be found in the following locations:

- Goal 1 visual summary: Table 20, beginning on page 32;
- Goal 2 visual summary: Table 21, beginning on page 34;
- Goal 3 visual summary: Table 22, beginning on page 37; and
- Goal 4 visual summary: Table 23, beginning on page 38.

Each of these four tables spans multiple pages.

Table 20. Visual summary of progress on Goal 1 during 2023. The "Time-Frame" column indicates the expected timeframe for each action item, as indicated in the basin-wide plan. The "Action Taken" column refers to whether the action item was worked on in 2023, and the "Progress" column contains more information about progress during 2023. For details about the progress on each action item, see the page number indicated in the rightmost column.

Action Item	Description	Time Frame	Action Taken	Progress	Page
Goal 1	**Maintain Nebraska's compliance with the Republican River Compact and applicable laws**				
Obj. 1.1	**Coordinate basin-wide management actions with Compact compliance efforts and adherence to state laws**				
1.1.1	*Review each basin-wide plan management action prior to implementation to ensure it does not negatively impact efforts to achieve Compact compliance in the most efficient and cost-effective way practicable while adhering to state laws.*		Yes		39
1.1.2	*Implement appropriate offsets for any basin-wide plan action that would exceed Nebraska's allocation under the Compact*		No	**N/A**	39
Obj. 1.2	**Understand effects of management actions for compact compliance on water supplies for State's water users**				
1.2.1	*Qualitatively evaluate the net effect on water supplies of any management actions that are taken for Compact compliance*		Yes		40
Obj. 1.3	**Assess progress toward meeting the goals and objectives of the Plan, and share the results of this assessment with the Public and the Nebraska Legislature**				
1.3.1	*Within five years after the adoption of this Plan, and every five years thereafter, conduct a technical analysis of the actions taken to determine the progress toward meeting the goals and objectives of the Plan*		Yes		41

Symbol Legend – See Figure 9 on page 31

Action Item	Description	Time Frame	Action Taken	Progress	Page
1.3.2	*Evaluate progress toward each of the Plan's measurable hydrologic objectives at the intermediate dates specified in the Plan for each one.*				
MHO A:	*Maintain each NRD's net groundwater depletions to streamflow within its portion of Nebraska's allowable groundwater depletions to streamflow.*	ANNUAL	Yes		41
MHO B:	*Limit groundwater depletions to streamflow to a relatively constant level over the long-term both across the basin as a whole and within each NRD*	5	Yes	**N/A**	41
MHO C:	*Ensure there is always enough groundwater for all groundwater uses within the timeframe of this plan, either by stabilizing groundwater levels or managing declining groundwater levels*	5	Yes		42
MHO D:	*Continue existing and initiate new actions that reduce the need for special regulations in the Rapid Response Area for Compact compliance*	ANNUAL	Yes		42
MHO E:	*Continue existing and initiate new actions that reduce the need for administration of surface water use for Compact compliance*	ANNUAL	Yes		43
1.3.3	*Following each five-year technical analysis (Action Item 1.3.1), share the results of the analysis and any recommended Plan modifications with the public*	5	Yes		43
1.3.4	*Following each five-year technical analysis (Action Item 1.3.1) and any resulting modifications to the Plan, submit a report to the Legislature of the results of the analysis and progress made under the Plan*	5	Yes		43

Symbol Legend – See Figure 9 on page 31

Table 21. Visual summary of progress on Goal 2 during 2023. The "Time-Frame" column indicates the expected timeframe for each action item, as indicated in the basin-wide plan. The "Action Taken" column refers to whether the action item was worked on in 2023, and the "Progress" column contains more information about progress during 2023. For details about the progress on each action item, see the page number indicated in the rightmost column.

Action Item	Description	Time Frame	Action Taken	Progress	Page
Goal 2	**Maximize Nebraska's efficient and beneficial consumptive use of its water, increase certainty for long-range planning of water supplies to reduce the need for regulatory actions, and increase collaborative efforts among water management entities and stakeholders across the Basin**				
Obj. 2.1	**Understand potential impacts of actions and establish standard procedure for projects**				
2.1.1	*For each planned new water management project in the Plan, evaluate hydrologic and regulatory feasibility and potential economic and environmental impacts*		Yes		44
2.1.2	*For each project evaluated in accordance with Action Item 2.1.1 in a given year, include a summary of the evaluation in the annual report of that year's activities*		Yes		44
2.1.3	*For projects that are feasible and beneficial, apply for necessary permits, establish new or utilize existing infrastructure, then begin operations*		Yes		45
Obj. 2.2	**Improve the efficiency of use, availability, and reliability of water supplies for current irrigators**				
2.2.1	*Work with irrigation districts and individual groundwater and surface water irrigators to improve the efficiency of the Basin's surface water delivery systems and irrigation water use, when it is both feasible and beneficial to Nebraska's Compact accounting balance*		Yes		46
2.2.2	*Participate in projects to improve the reliability, availability, and sustainability of water supplies in the Basin, which may include but are not limited to* • *Voluntary reduction of irrigated acres (temporary or permanent)* • *Interbasin transfers* • *Conjunctive management projects such as aquifer recharge or streamflow augmentation*		Yes		47
Obj. 2.3	**Provide opportunities for collaboration among Basin's water users**				
2.3.1	*Hold an annual public meeting to discuss Plan implementation and exchange information about the Basin*		Yes		49

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Action Item	Description	Time Frame	Action Taken	Progress	Page
2.3.2	*Work cooperatively to investigate and address conflicts between water users resulting from implementation of this Plan by following the procedures for addressing conflicts that are outlined in this Plan*		No	**N/A**	49
Obj. 2.4	**Promote conservation programs available to the water users in the Basin**				
2.4.1	*Work together to identify, investigate, and discuss existing and potential new water conservation programs*		Yes		49
2.4.2	*Collaborate to promote conservation program opportunities to the Basin's water users*		Yes		50
Obj. 2.5	**Understand how management activities of independent decision-makers affect water supplies**				
2.5.1	*Study the effects of conservation practices on streamflow, if feasible*		Yes		51
2.5.2	*As part of each five-year technical analysis, analyze the future impacts to streamflow of past pumping to determine the lag time of these residual impacts*		Yes		51
2.5.3	*Examine and attempt to estimate the quantity of all inputs and outputs affecting the water supply balance in a small watershed, and consider using the results of this pilot study to create water use and land use guidelines for producers and other land managers, incentivize participation in recommended practices, and determine the value of completing similar studies across the Basin*		Yes		52
Obj. 2.6	**Evaluate the feasibility and potential outcomes of establishing water markets in the Basin**				
2.6.1	*Cooperate in determining the feasibility of water markets in the Basin*		Yes		53
2.6.2	*Following the water markets feasibility analysis (Action Item 2.6.1), test conclusions through implementation of a water market program in a pilot area, if feasible*		No	**N/A**	54
Obj. 2.7	**Support the NRDs in management of allocations for irrigation purposes and surface water irrigation districts in management of the allotment of their water supply**				
2.7.1	*Periodically evaluate, as part of each five-year technical analysis, the impact of the groundwater allocation and surface water allotment systems as a whole*		Yes		54

Symbol Legend – See Figure 9 on page 31

Action Item	Description	Time Frame	Action Taken	Progress	Page
2.7.2	*As needed, based on the evaluation described in Action Item 2.7.1, recommend changes or improvements to the groundwater allocation and/or surface water allotment systems*	5	Yes	●	55
Obj. 2.8	**Conserve water for future use during a drought**				
2.8.1	*Organize and participate in a Basin-wide drought planning exercise*	'23	Yes	★	55
2.8.2	*Following the drought planning exercise (Action Item 2.8.1) evaluate whether to recommend any changes to the IMPs or this Plan related to conservation of water for future use during a drought*	'24	No	●	56

Symbol Legend – See Figure 9 on page 31

Table 22. Visual summary of progress on Goal 3 during 2023. The "Time-Frame" column indicates the expected timeframe for each action item, as indicated in the basin-wide plan. The "Action Taken" column refers to whether the action item was worked on in 2023, and the "Progress" column contains more information about progress during 2023. For details about the progress on each action item, see the page number indicated in the rightmost column.

Action Item	Description	Time Frame	Action Taken	Progress	Page
Goal 3	**Positive public relations, including information sharing, within and outside the Basin**				
Obj. 3.1	**Improve information sharing with decision-makers and public about solutions within the Basin**				
3.1.1	*Use existing resources to share information about Basin progress and activities with outside entities*		Yes		57
3.1.2	*Educate civic leaders and the public on implementation efforts within the Basin*		Yes		57
3.1.3	*Educate civic leaders and the public about the policies and institutional infrastructure that contribute to the development and implementation of solutions*		Yes		58
3.1.4	*Propose and support changes to laws, policies, and rules that would incentivize reduced water consumption*		No	**N/A**	59
Obj. 3.2	**Improve information sharing with water users who are reliant on the Basin's water supplies**				
3.2.1	*Share data and information related to the Republican River Compact with the public in an easily accessible, user-friendly format*		Yes		59
3.2.2	*Annually prepare and exchange reports containing data and information about water supplies and uses in the Basin, and make these reports publicly known*		Yes		60
3.2.3	*Regularly communicate with the Plan's former Stakeholder Advisory Committee about implementation progress and potential Plan revisions*		Yes		60
3.2.4	*Encourage and support water users to share information about their management practice improvements with other water users and the public*		Yes		61

Symbol Legend – See Figure 9 on page 31

Table 23. Visual summary of progress on Goal 4 during 2023. The "Time-Frame" column indicates the expected timeframe for each action item, as indicated in the basin-wide plan. The "Action Taken" column refers to whether the action item was worked on in 2023, and the "Progress" column contains more information about progress during 2023. For details about the progress on each action item, see the page number indicated in the rightmost column.

Action Item	Description	Time Frame	Action Taken	Progress	Page
Goal 4	**When possible, pursue projects that not only benefit water supplies and uses, but also create benefits for fish, wildlife, recreation and conveyance within the Republican River Basin**				
Obj. 4.1	**Protect and enhance fish and wildlife habitat and recreational opportunities**				
4.1.1	*Partner with wildlife-focused organizations on projects that benefit the organizations' habitat and wildlife interests while also helping to fulfill other goals of the Plan*		Yes		63
4.1.2	*Promote public recreation on the river, when doing so can also help to fulfill other goals of the Plan*		Yes		63
4.1.3	*Cooperate in projects to assess and restore riparian wetlands while also helping to fulfill other goals of the Plan*		Yes		64
Obj. 4.2	**Where feasible and beneficial, reduce the effects of undesirable vegetation on water conveyance**				
4.2.1	*Cooperate in removing undesirable vegetation impacting water conveyance and managing reinfestation*		Yes		64

Symbol Legend – See Figure 9 on page 31

Progress Summaries

This section contains descriptions summarizing 2023 progress on each action item. For actions marked as not applicable ("N/A") the summaries include explanations of why progress did not need to be taken on those action items in 2023. For a copy of any reference materials mentioned in these summaries, please contact NeDNR or one of the Republican Basin NRDs.

Goal 1	**Maintain Nebraska's compliance with the Republican River Compact and applicable laws**
Obj. 1.1	**Coordinate basin-wide plan management actions with Nebraska's Compact compliance efforts and adherence to applicable state laws**

1.1.1 *Review each basin-wide plan management action prior to implementation to ensure it does not negatively impact efforts to achieve Compact compliance in the most efficient and cost-effective way practicable while adhering to state laws.*

In 2023, all basin-wide plan management actions were reviewed in accordance with Action Item 1.1.1. The Republican Basin NRDs and NeDNR do not expect any 2023 basin-wide plan management actions to negatively impact efforts to achieve Compact compliance in the most efficient and cost-effective way under state law.

Based on our review of the potential future basin-wide plan management actions outlined in the basin-wide plan, we do not expect any will negatively impact Compact compliance efforts or adherence to state laws. As new management actions are proposed, we will thoroughly analyze them at that time.

1.1.2 *Implement appropriate offsets for any basin-wide plan action that would exceed Nebraska's allocation under the Compact*

N/A

For this action item, the basin-wide plan defines offsets as actions that either reduce water use or increase water supply for the purpose of staying within Nebraska's Compact allocation. Nebraska complied with the Compact in 2023 without the need for any offsets by NeDNR or the Republican Basin NRDs. Because no offsets were necessary, this action item is not applicable for 2023.

In years when offsets are required, the volume of water that each NRD needs to make up through management actions is determined through procedures described in the *Monitoring & Studies Technical Memorandum for the URNRD, MRNRD, and LRNRD IMPs* (effective 9/27/2021). The IMPs for Upper Republican, Middle Republican, and Lower Republican NRDs require each district's computed beneficial consumptive water use to remain within its share of Nebraska's Compact allocation. The IMP for the Republican Basin portions of Tri-Basin NRD states that the district will incrementally achieve and sustain a hydrologically balanced condition so that, in combination with imported water contributions from the Platte Basin, streamflow augmentation, and other management

Symbol Legend – See Figure 9 on page 31

actions, Tri-Basin NRD water users will not cause a net depletion to streamflow. Through implementation of the IMPs, NeDNR and the Republican Basin NRDs will take any necessary offsetting actions to ensure that Nebraska remains in compliance with the Compact.

In October 2023, Kansas requested administration of 1,860 acre-feet of Remaining Compact Compliance Volume (RCCV) from 2016. The water was administered into the Kansas irrigation supply in Harlan County Lake in late 2023 during the non-irrigation season. The RCCV balance was zero at the end of 2023. MHO E was achieved in 2023 because surface water was not administered for Compact Compliance (no irrigators were shut down during irrigation season), and the RCCV was water generated through NRD management actions.

Obj. 1.2 Understand the effects of management actions for Compact compliance on water supplies for Nebraska's water users

1.2.1 *Qualitatively evaluate the net effect on water supplies of any management actions that are taken for Compact compliance*

This action item was completed during 2023. A qualitative evaluation of the net effect on water supplies of any management actions that were taken for Compact compliance during 2022 was presented at the fifth annual meeting to review progress on the basin-wide plan, which took place in November 2023. The qualitative evaluation can be found on page 27 of the *Fifth Annual Report for the Republican River Basin-Wide Plan: Data and Progress Updates, 2022 (November 15, 2023)* and can be downloaded from the basin-wide plan website, *https://rrbwp.nebraska.gov .*

The current year's qualitative evaluation of the net effect of 2023 management actions for Compact compliance on water supplies can be found under "Qualitative Evaluation of Net Effect of Management Actions for Compact Compliance" on page 27 of this report.

Upper Republican NRD evaluated offers from landowners to permanently decertify irrigated land to aid in Compact compliance. The district, in conjunction with WRCF cost share from NeDNR, decertified approximately 583 groundwater-irrigated acres near and adjacent to the Republican River.

Middle Republican NRD entered into one contract with a landowner to permanently decertify 40 groundwater-irrigated acres and 20 surface water-irrigated acres.

Upon evaluation of the net effect on water supplies for management actions that have been taken for Compact compliance, Lower Republican NRD believes they have been effective and helped keep the state of Nebraska in compliance. Also, actions during full water supply have a residual effect during subsequent years. For example, crop-rotation along with no-till farming maintains moisture in the ground and reduces evaporation.

Symbol Legend – See Figure 9 on page 31

Each NRD reports on decertifications in the "Conservation and Irrigation Decertification Programs" section of the NRD summary under "*Water Supplies and Uses in the Basin*."

Obj. 1.3 **Assess progress toward meeting the goals and objectives of the Plan, and share the results of this assessment with the Public and the Nebraska Legislature**

1.3.1 *Within five years after the adoption of this Plan, and every five years thereafter, conduct a technical analysis of the actions taken to determine the progress toward meeting the goals and objectives of the Plan*

NeDNR and the Republican Basin NRDs completed the first five-year technical analysis in 2023. Results of this analysis were presented at the fifth annual meeting to review progress on the basin-wide plan, which took place in November 2023. The report was submitted to the legislature on February 29, 2024, and is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov .*

1.3.2 *Evaluate progress toward each of the Plan's measurable hydrologic objectives at the intermediate dates specified in the Plan for each one.*

MHO A: *Maintain each NRD's net groundwater depletions to streamflow within its portion of Nebraska's allowable groundwater depletions to streamflow.*

MHO A was evaluated for 2022, and the results were presented at the fifth annual meeting to review progress on the basin-wide plan, which took place in November 2023. The analysis and results are described beginning on page 63 of the *Fifth Annual Report for the Republican River Basin-Wide Plan: Data and Progress Updates, 2022 (November 15, 2023),* which can be downloaded from the basin-wide plan website, *https://rrbwp.nebraska.gov*.

The current year's (2023) evaluation of MHO A can be found under "MHO A Evaluation" on page 65 of this report.

MHO B: *Limit groundwater depletions to streamflow to a relatively constant level over the long-term both across the basin as a whole and within each NRD*

N/A

An assessment of MHO B was completed in 2023 as a subset of the five-year technical analysis, and the results were presented at the fifth annual meeting to review progress on the basin-wide plan, which took place in November 2023. The analysis methods and results can be found in the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report which was submitted to the legislature on February 29, 2024, and is available for download on the basin-wide plan

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website, *https://rrbwp.nebraska.gov* . The next five-year technical analysis will be completed in 2028.

MHO C: *Ensure there is always enough groundwater for all groundwater uses within the timeframe of this plan, either by stabilizing groundwater levels or managing declining groundwater levels*

The first screening phase of the MHO C analysis (Phase I) was completed in 2023 as a subset of the five-year technical analysis, and the results were presented at the fifth annual meeting to review progress on the basin-wide plan, which took place in November 2023. The analysis methods and results can be found in the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report which was submitted to the legislature on February 29, 2024, and is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov.*

In Phase I, spring groundwater levels of basin wells were statistically analyzed using the Mann-Kendall Trend Test to identify any areas containing wells with groundwater levels declining at such a rate that there will not be enough groundwater available for all groundwater uses within the timeframe of the Plan. Wells identified in Phase I as having a decreasing trend in average spring groundwater levels will be further analyzed in Phase II and III to determine if the NRDs will need to implement additional management actions. As described in the Plan, Phase II and III will be conducted in upcoming years.

The next five-year technical analysis will be completed in 2028.

MHO D: *Continue existing and initiate new actions that reduce the need for special regulations in the Rapid Response Area for Compact compliance*

MHO D assesses whether groundwater pumping within the Rapid Response Area of Upper Republican, Middle Republican, or Lower Republican NRD was curtailed to ensure Compact compliance during the previous year. There is no Rapid Response Area designated within Tri-Basin NRD.

MHO D was evaluated for 2022 to review progress on the basin-wide plan. Results were presented at the fifth annual meeting, which took place in November 2023. The analysis and results can be found on page 68 of the *Fifth Annual Report for the Republican River Basin-Wide Plan: Data and Progress Updates, 2022 (November 15, 2023).* The report can be downloaded from the basin-wide plan website, *https://rrbwp.nebraska.gov*.

The current year's evaluation of MHO D can be found under "MHO D Evaluation" on page 69 of this report.

The Republican Basin NRDs and NeDNR have undertaken many projects that reduce the potential future need for special regulations in the Rapid Response Area for Compact compliance. Examples of new and existing projects can be found in this report, within the summaries of progress on other plan action items.

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MHO E: *Continue existing and initiate new actions that reduce the need for administration of surface water use for Compact compliance*

MHO E assesses whether surface water administration was needed during the previous year to ensure Compact compliance. Note that any administration that is automatically triggered under terms of the FSS is not evaluated as part of MHO E.

MHO E was evaluated for 2022 to review progress on the basin-wide plan. Results were presented at the fifth annual meeting, which took place in November 2023. The analysis and results can be found on page 69 of the *Fifth Annual Report for the Republican River Basin-Wide Plan: Data and Progress Updates, 2022 (November 15, 2023),* which can be downloaded from the basin-wide plan website, *https://rrbwp.nebraska.gov* .

The current year's evaluation of MHO E can be found under "MHO E Evaluation" on page 70 of this report.

NeDNR and the Republican Basin NRDs have undertaken many projects that reduce the potential future need for surface water administration for Compact compliance. Some examples are included in this report, within the summaries of progress on other plan action items.

1.3.3 *Following each five-year technical analysis (Action Item 1.3.1), share the results of the analysis and any recommended Plan modifications with the public*

The first five-year technical analysis was conducted in 2023. Results of the analysis were shared with the public at the fifth annual meeting to review progress on the basin-wide plan, which took place in November 2023. No modifications to the Plan were proposed by NeDNR or the Basin NRDs after consideration of the analysis results.

1.3.4 *Following each five-year technical analysis (Action Item 1.3.1) and any resulting modifications to the Plan, submit a report to the Legislature of the results of the analysis and progress made under the Plan*

A report entitled *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* which includes descriptions of analysis methods and results was completed in 2023 and submitted to the legislature on February 29, 2024. This report is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*.

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Goal 2	**Maximize Nebraska's efficient and beneficial consumptive use of its water, increase certainty for long-range planning of water supplies to reduce the need for regulatory actions, and increase collaborative efforts among water management entities and stakeholders across the Basin**
Obj. 2.1	**Understand the feasibility and potential impacts of Plan actions and establish a standard procedure for projects**

2.1.1 *For each planned new water management project in the Plan, evaluate hydrologic and regulatory feasibility and potential economic and environmental impacts*

and

2.1.2 *For each project evaluated in accordance with Action Item 2.1.1 in a given year, include a summary of the evaluation in the annual report of that year's activities*

Upper Republican NRD utilized a newly developed groundwater model of the URNRD to evaluate hydrologic impacts of proposed water-use relocations. The information was used conjunctively with regulations designed to prevent such transfers from causing an increase in groundwater use. Evaluation of groundwater levels under different regulatory and transfer scenarios occurred but not for the purposes of new water-management projects in the Plan.

In March 2023, Upper Republican NRD executed an agreement with NeDNR that obligates $1,112,067 in state WRCF money for automation of flow meters and installation of soil-moisture probes in the district. The five-year contract will help Upper Republican NRD complete its conversion of all flow meters from mechanical units that must be read manually to automated, telemetry-enabled ones that transmit water-usage data hourly via a radio network. The project is intended to improve district-wide water-management efforts and farmers' irrigation scheduling. WRCF funds obligated in the contract may also be used by Upper Republican NRD to provide cost-share to irrigators for use of soil-moisture probes that help eliminate unnecessary irrigation applications.

Lower Republican NRD utilizes a model specific for proposed new water management projects. The NRD is evaluating proposed locations for potential water storage and streamflow augmentation. These efforts initiated the National Environmental Policy Act (NEPA), analyzing all the components relevant to such projects. Lower Republican NRD received funding through the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Watershed and Flood Prevention Operations Program (WFPO) and hired a consultant to further evaluate the proposed sites for water storage, streamflow augmentation, and other beneficial uses. The WFPO grants that the district received for two of the proposed sites will be completed by December 2024.

In 2023, Lower Republican NRD signed a contract with NeDNR for automation of flow meters and development of an augmentation project on Flag Creek (Figure 10). Work on those projects started in 2024.

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Figure 10. Construction of Flag Creek augmentation project

Middle Republican NRD plans on completing the district's telemetry irrigation meter project by the end of 2025. Over 2000 meters have been installed utilizing the WaterSMART Program and the NeDNR WRCF. These telemetry meters will provide real time irrigation usage data to all irrigators in the MRNRD providing the means for improved application efficiency and reduced water usage.

In 2023, Tri-Basin NRD signed a contract with NeDNR to use WRCF funds to enable cost-sharing on remote-read flowmeters and soil moisture sensors.

2.1.3 *For projects that are feasible and beneficial, apply for necessary permits, establish new or utilize existing infrastructure, then begin operations*

For future projects that are feasible and beneficial, basin NRDs will apply for necessary permits, establish new or utilize existing infrastructure, and then begin operations.

In 2020, Tri-Basin and Lower Republican NRDs resubmitted their application (permit number A-19594) for a water right to divert excess flows from the Platte River for delivery to a diversion that would send water down Turkey Creek, a tributary of the Republican River. Evaluation of the permit application by NeDNR is ongoing. All ongoing and future projects will be developed in compliance with local, state, and federal permitting requirements.

Obj. 2.2 Improve the efficiency of use, availability, and reliability of water supplies for current irrigators

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2.2.1 *Work with irrigation districts and individual groundwater and surface water irrigators to improve the efficiency of the Basin's surface water delivery systems and irrigation water use, when it is both feasible and beneficial to Nebraska's Compact accounting balance*

Upper Republican NRD, Middle Republican NRD, Lower Republican NRD, and NeDNR each made progress on this action item in 2023.

Upper Republican NRD continued to provide tools to improve irrigation scheduling including daily evapotranspiration data for all crops grown in the district through use of district-owned weather stations and those operated in partnership with the University of Nebraska's Water for Food Institute. The District also incentivized the use of 125 soil-moisture probes on approximately 16,000 acres by providing cost share for probes utilizing district and state Water Sustainability Fund funds.

Irrigators who requested it were provided up-to-date water usage data and remaining allocation from telemetry-equipped flow meters that have been installed in the District

(Figure 11).

Figure 11. Two different mounting systems for Upper Republican NRD telemetry project.

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Middle Republican continued to support Frenchman Cambridge Irrigation District (FCID) on their efficiency efforts.

Middle Republican NRD has an ongoing project with the Frenchman Valley Irrigation District (FVID) to conduct recharge through their surface delivery system and use the water for Compact compliance if necessary.

Lower Republican NRD has an agreement with the Nebraska Bostwick Irrigation District (NBID) that establishes water savings through the placement of automated gates.

Additional information about telemetry meter and soil moisture probe projects by basin NRDs is reported under Action Item 2.1.1 and Action Item 2.1.2.

Figure 12. New Rubicon gates on canal operated by Frenchman-Cambridge Irrigation District.

In 2021, NeDNR signed a contract with NBID to provide matching funds for a large scale WaterSMART Grant from the USBR, which LRNRD and NeDNR provided letters of support for. NBID was awarded a two and a half million-dollar contract through WaterSmart, which combined with NeDNR WRCF funds will build and install a diversion site on the Republican River on the east side of Superior. When this project is operational, it will save approximately 3,500 to 4,000 acre feet of water from being released from Harlan County Reservoir. In 2023, progress was made on project design and securing an easement agreement. The project is expected to be operational by the 2025 water season.

NeDNR signed a contract with the Frenchman-Cambridge Irrigation District (FCID) in 2020 to install upgraded flow measurement and control gates on the Meeker-Driftwood Canal and integrate them into a Supervisory Control and Data Acquisition (SCADA) radio telemetry network (Figure 12). No work was done on this project in 2023 because there was no water in the canal (due to drought conditions).

2.2.2 *Participate in projects to improve the reliability, availability, and sustainability of water supplies in the Basin, which may include but are not limited to:*

- *Voluntary reduction of irrigated acres (temporary or permanent)*
- *Interbasin transfers*
- *Conjunctive management projects such as aquifer recharge or streamflow augmentation*

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All four Republican River Basin NRDs participate in CREP, which provides federal funding for the temporary removal of environmentally sensitive land from production. Summaries of acres enrolled in CREP within each NRD can be found on pages 8, (Upper Republican NRD), page 11 (Middle Republican NRD), page 14 (Lower Republican NRD), and page 16 (Tri-Basin NRD).

Upper Republican NRD executed agreements with two landowners that will permanently decertify approximately 583 acres. One of the decertification's affects 130 acres where pumping has a stream-depletion factor of 34% and average, annual water usage had been about 12 inches per acres. The land is enrolled in CREP. The second permanent decertification is comprised of 453 acres where pumping has an average stream-depletion factor of 84% and average annual water usage has been approximately 12.5 inches per acre. That land is not enrolled in CREP. The decertifications were completed using district and NeDNR WRCF funds.

Middle Republican NRD has a program to decertify irrigation rights or appropriations on cropland. This program is funded by Middle Republican NRD and NeDNR's WRCF. In the fall of 2023, Middle Republican NRD entered into two new decertification projects on 60 acres, 20 acres of surface water and 40 acres of groundwater. The surface water acres had a stream-depletion factor of 100%. The groundwater acres had a stream depletion factor of 81% and an average annual water usage of 12.8 inches per acre.

Lower Republican and Tri-Basin NRD submitted an application to NeDNR for an interbasin transfer permit to divert excess flows from the Platte Basin to the Republican Basin as the Platte to Republican Basin High Flow Diversion (PRD) project (permit number A-19594, Figure 13). As filed, it was proposed to always be junior in priority to existing and future Platte River water uses. Evaluation of the permit application by NeDNR is ongoing. Permitting aspects of this project are described under action item 2.1.3.

Figure 13. Prescribed burn on Platte-Republican Diversion land, April 20, 2020, courtesy of Tri-Basin NRD.

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Lower Republican NRD has agreements with NBID to use water stored in Harlan County Lake for Compact compliance. The stored water is a result of water savings derived from automated gate installations, which received a million dollars from Lower Republican NRD.

Upper, Middle, and Lower Republican NRDs continue to support the N-CORPE Augmentation Project.

Additional potential conjunctive management projects NeDNR and the NRDs were involved in with the basin's irrigation districts are described under action item 2.2.1.

Obj. 2.3 Provide opportunities for collaboration among Basin's water users

2.3.1 *Hold an annual public meeting to discuss Plan implementation and exchange information about the Basin*

The first basin-wide plan annual meeting was held in February 2020, which was within the first year of plan implementation.

The second through fifth basin-wide plan annual meetings were held in November 2020, November 2021, November 2022 and November 2023, respectively, in fulfillment of the IMPs for Upper Republican, Middle Republican, and Lower Republican NRDs. The main purpose of these meetings is to present to the public progress by NRDs and NeDNR on Plan implementation in the Basin in the previous year.

2.3.2 *Work cooperatively to investigate and address conflicts between water users resulting from implementation of this Plan by following the procedures for addressing conflicts that are outlined in this Plan*

N/A

The Republican River NRDs and NeDNR intend to work cooperatively to investigate and address conflicts between water users resulting from implementation of the Basin-Wide Plan by following the procedures for addressing conflicts that are outlined in the Plan. In 2023, no conflicts resulting from implementation of the basin-wide plan were brought to the attention of NeDNR or the NRDs to address.

Obj. 2.4 Promote conservation programs available to the water users in the Basin

2.4.1 *Work together to identify, investigate, and discuss existing and potential new water conservation programs*

Throughout 2023, the Republican Basin NRDs and NeDNR discussed and shared information with each other about existing and potential new water conservation programs as new information became available or new questions were raised by one of the parties. Recent examples include information exchange on federal water conservation

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grants, flow meter telemetry, stream flow augmentation operations, and water use regulations. The NRDs support individual efforts of other NRDs as well as programs for the whole basin.

Upper, Middle, and Lower Republican NRDs are in partnership on streamflow augmentation projects and other water use regulations. The three NRDs jointly presented information about water issues in the basin to the University of Nebraska-Lincoln Leadership Education/Action Development (LEAD) program.

For Upper Republican NRD, 2023 was the first year of the district's new 5-year allocation period. The allocation was reduced from a total of 65 inches per acre over the 5-year period to 62.5 inches resulting in an annual, average allocation of 12.5 inches per acre. The previous average was 13 inches per acre.

Lower Republican NRD also has an agreement with NBID to use a portion of water savings from automated gates for Compact compliance. The NRD provided one million dollars for the gates.

Lower Republican NRD supported and provided funding for NBID's Superior Canal WaterSMART project and is utilizing a WaterSMART grant from the USBR to implement a program for telemetry-enabled flowmeters. See the description under Action Item 2.2.1 for details. NeDNR supported the two above mentioned projects by providing funding through the WRCF.

Tri-Basin NRD created the Water Conservation Incentive Program (WCIP) to encourage irrigators to accept limits on their water use in exchange for receiving cash payments if they save water within their allocation period. Landowners also get flexibility to use their limited allocation on uncertified irrigated acres. Agreements last five years. Landowners have 1,444 certified irrigated acres enrolled in the program. This effort is funded by Tri-Basin NRD and NeDNR's WRCF.

Additional information about telemetry meter and soil moisture probe projects by basin NRDs is reported under Action Item 2.1.1 and Action Item 2.1.2.

2.4.2 *Collaborate to promote conservation program opportunities to the Basin's water users*

The Republican River Basin NRDs and NeDNR are open to opportunities to collaborate with neighboring NRDs, state and federal government agencies and constituents on programs and projects that promote and incentivize water conservation. Each of the Republican Basin NRDs is actively involved in CREP. Additionally, the NRDs participate in the Southwest Weed Management District (SWMD), and Lower Republican NRD is an active member of Twin Valley Weed Management Area (TVWMA). SWMD and TVWMA have removed invasive species in stream corridors that consume water and impede stream flow.

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Upper Republican NRD worked with the USDA's Natural Resources Conservation Service and local stakeholders to identify priorities for water-conservation efforts funded by USDA.

Obj. 2.5 Understand how various water management activities of independent decision-makers affect water supplies

2.5.1 *Study the effects of conservation practices on streamflow, if feasible*

This action item is to be completed by 2028, when and if funding and staff resources allow. NeDNR and the NRDs have some analytical tools available to them to assist with studies of the effects of conservation practices on streamflow, as described below.

Upper Republican NRD continued to be an active participant in the Southwest Weed Management District's efforts to identify areas where grant funds could be used to eradicate non-desirable vegetation that negatively impacts stream flow.

Lower Republican NRD will study the effects of conservation practices on streamflow through the Lower Republican NRD Management Action Opportunity (MAO) model. The RRCA model is run to determine the quantitative effect of a proposed land use change through the MAO model.

Tri-Basin NRD has the most extensive groundwater level monitoring network in Nebraska. Groundwater level data is critical to accurately determining impacts of groundwater pumping on streamflows. Data are shared with state and federal agencies and made available to the public.

A literature review of the effects of select water and soil conservation practices on streamflow was completed as a supplemental report to the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report. The literature review is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*.

NeDNR uses the RRCA model to estimate stream depletions resulting from groundwater pumping, stream accretions resulting from recharge projects, and other parameters.

2.5.2 *As part of each five-year technical analysis, analyze the future impacts to streamflow of past pumping to determine the lag time of these residual impacts*

An analysis of the future impacts to streamflow of past pumping was completed in 2023 as a subset of the first five-year technical analysis, and the results were presented at the fifth annual meeting to review progress on the basin-wide plan, which took place in November 2023. Results of this analysis suggest that estimated groundwater depletions from historical groundwater pumping would continue through the end of the timeframe

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for implementation of the basin-wide plan (2044) even if pumping were to have completely ceased beginning in 2022. Further details on the analysis methods and results can be found in the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report which was submitted to the legislature on February 29, 2024, and is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*.

2.5.3 *Examine and attempt to estimate the quantity of all inputs and outputs affecting the water supply balance in a small watershed, and consider using the results of this pilot study to create water use and land use guidelines for producers and other land managers, incentivize participation in recommended practices, and determine the value of completing similar studies across the Basin*

This action item is to be completed by 2028.

Upper Republican NRD continued to collaborate with the Nebraska Water Balance Alliance and the University of Nebraska's Daugherty Water for Food Global Institute to quantify all inputs and outputs within the HUC-12 watershed in Perkins County. Evapotranspiration, recharge, and precipitation data were collected in 2023. Analysis is expected to continue through 2024.

In 2021, Middle Republican NRD received a Water Sustainability Grant to use airborne electromagnetic (AEM) technology to model water supply balance in the whole irrigated portion of Middle Republican NRD (Figure 14). Data collection and analysis are ongoing, and the project is progressing as planned.

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Figure 14. Helicopter collecting AEM data in Middle Republican NRD.

Lower Republican NRD will examine the effort required to complete action item 2.5.3 in the coming years, attempting to estimate the quantity of all inputs and outputs affecting the water supply balance in a small watershed and will consider using the results of this pilot study to create water use and land use guidelines for producers and other land managers, incentivize participation in recommended practices, and determine the value of completing similar studies across the Basin.

Obj. 2.6 Evaluate the feasibility and potential outcomes of establishing water markets in the Basin

2.6.1 *Cooperate in determining the feasibility of water markets in the Basin*

This action item was completed in 2023; it was a collaboration between basin NRDs, NeDNR, and UNL. NeDNR began the Basin-wide water market feasibility analysis with a review of scientific literature on the nature of water markets and analyses of existing water markets throughout the world. In May of 2023, NeDNR and the Basin NRDs, in conjunction with the UNL Public Policy Center, conducted a survey of Basin stakeholders to determine interest in water markets. The survey results indicated there was low interest amongst Basin stakeholders in a potential water market; a majority (55%) of respondents disagreed that they would be willing to buy and/or sell water in a potential water market (40% strongly disagreed). The report by NeDNR, which includes the report on survey results by

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the UNL Public Policy Center, is available on the basin-wide plan website *https://rrbwp.nebraska.gov*.

2.6.2 *Following the water markets feasibility analysis (Action Item 2.6.1), test conclusions through implementation of a water market program in a pilot area, if feasible*

N/A

After conducting the Basin-wide water market feasibility analysis described above, NeDNR and the Basin NRDs do not plan on conducting a water market pilot program. Such a program was determined to be infeasible due to the statutory and Compact compliance barriers, such as limitations on transferring water rights, and limited interest from Basin stakeholders as determined via the interest survey. In addition, it was determined that smaller, local water markets already existed where there was demand.

Obj. 2.7 **Support the NRDs in management of allocations for irrigation purposes and surface water irrigation districts in management of the allotment of their water supply**

2.7.1 *Periodically evaluate, as part of each five-year technical analysis, the impact of the groundwater allocation and surface water allotment systems as a whole*

NeDNR and the Republican Basin NRDs evaluated the impact of the groundwater allocation and surface water allotment systems for the first five-year technical analysis in 2023. Results were presented at the fifth annual meeting to review progress on the basin-wide plan, which took place in November 2023. Results of this evaluation can be found in the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report which was submitted to the legislature on February 29, 2024, and is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*.

The NRDs individually review pumping and allocations on a regular basis to comply with the IMPs and groundwater management plans while balancing the allocations so as not to restrict the economic vitality of the NRD or the region, as is consistent with the mission of the *Republican River Basin-Wide Plan*.

Upper Republican NRD used its groundwater model internally to determine the long-term impacts on groundwater levels caused by different allocation scenarios.

Although the Republican River Basin Wide Plan requires a five-year periodic evaluation for the technical analysis to determine the impact of the groundwater allocation, Lower Republican NRD always reviews pumping and allocations to comply with the Integrated Management Plan (IMP) while balancing the allocations so that it does not restrict the economic vitality of the NRD or the region, which is consistent with the mission of the *Republican River Basin-Wide Plan*. Lower Republican NRD does not have authority to manage surface water irrigation district allotments, but

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does support the irrigation districts, their sponsors, and their sponsors' partners in evaluating additional storage of flood water.

Tri-Basin NRD has only one township in the Republican Basin that is subject to allocation. This allocation was imposed to protect groundwater levels in the local area from diminishment. The allocation requirement is tied to local groundwater levels. If a three-year average of groundwater levels rises above the 1981–1985 average springtime levels for that township, the allocation will be suspended. The other three NRDs have allocations district-wide.

2.7.2 *As needed, based on the evaluation described in Action Item 2.7.1, recommend changes or improvements to the groundwater allocation and/or surface water allotment systems*

At this time, no changes are recommended to either system. Both allow for efficient utilization of the existing water supply, and appropriate mechanisms are in place to ensure continued protection of existing water uses and administration of water rights as necessary to maintain Compact compliance.

A reduction in Upper Republican NRD's 5-year allocation was recommended by a subcommittee of the Board of Directors and approved by the Board in 2023. The reduction is intended to slow the rate of groundwater declines that occurs in the district. Lower Republican NRD would support the irrigation districts, their sponsors, and their sponsors' partners in evaluating additional storage of flood water within existing facilities that could be reserved for irrigation supply, aquatic habitat, and recreation. Lower Republican NRD supports NBID and the USBR's effort to develop a lake level management plan with the United States Army Corps of Engineers (USACE). The USACE Kansas City District reservoirs have this implemented. For example, the lake level management plan at Lovewell Reservoir supports the operation of KBID.

Obj. 2.8 Conserve water for future use during a drought

2.8.1 *Organize and participate in a Basin-wide drought planning exercise*

Preparation for the drought-planning exercise began in 2020 with the hiring of a graduate research assistant (GRA), working out of the National Drought Mitigation Center (NDMC). Research conducted in 2021 by the GRA and NeDNR staff was used to determine the type of exercise to hold, how to prioritize specific drought impacts, and the types of management actions that might be used to maintain Compact compliance.

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The Basin-wide drought planning exercise took place in May 2022 and the drought planning exercise report was completed in 2023. Details about the drought planning exercise outcomes are found in the *Report on the Republican River Basin Drought Planning Exercise* (November 15, 2023), which is available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*.

The Lower Republican NRD participated in the drought planning exercise with NeDNR and the other Republican basin NRDs. Additionally, the Lower Republican NRD believes that reserving flood water for irrigation use within existing structures would be beneficial for water supplies during drought periods. Many reservoirs in the USACE Kansas City District have lake management plans that allow additional water to be held back above conservation pools. Additionally, regulatory changes that allow for the modification or change in a reservoir operating plan allowing flood water retention above current levels would conserve water for future use.

2.8.2 *Following the drought planning exercise (Action Item 2.8.1) evaluate whether to recommend any changes to the IMPs or this Plan related to conservation of water for future use during a drought*

This action item will be completed by the year following completion of the drought planning exercise, and no later than 2024.

Basin NRDs and NeDNR determined that a drought plan for the basin is needed and discussed working collaboratively to complete such a plan. Components of the drought plan may include a communication plan, a drought dashboard, and a list of projects and initiatives to prevent or minimize damage caused by drought. It is unknown whether that effort will lead to changes in the IMPs or Basin-wide Plan.

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Goal 3	Positive public relations, including information sharing, within and outside the Basin
Obj. 3.1	**Improve information sharing with decision-makers and public about solutions within the Basin**

3.1.1 *Use existing resources to share information about Basin progress and activities with outside entities*

The Republican River Basin NRDs and NeDNR use existing information dissemination resources such as newsletters, radio programs, public meetings, websites, social media, and education/outreach events. Some of these resources were used in 2023 to share information about Basin progress and activities with outside entities. Examples are described under Action Item 3.1.2 and 3.1.3.

3.1.2 *Educate civic leaders and the public on implementation efforts within the Basin*

NeDNR and the Republican Basin NRDs participated in education and outreach about plan implementation efforts in 2023. The basin-wide plan identifies some examples of potential outreach topics related to this objective such as efficiency improvements, the NRDs' allocation systems and resulting successes, other management activities and successes, factors that have contributed to streamflow reduction in the Basin, variations in groundwater management that reflect natural wet/dry cycles, realistic expectations for outcomes of projects and policy changes. The following paragraphs provide specific examples of 2023 education and outreach activities related to implementation efforts within the basin.

NeDNR hosts a website about the Republican River Basin-Wide Plan, *http://rrbwp.nebraska.gov*. The website is a tool for conveying information about basin-wide plan implementation and includes background information about the plan and plan implementation resources such as data, annual meeting materials, and annual reports. Plan development meeting materials are also available on the website. NeDNR plans to update the website when staff and other resources are available.

Upper Republican NRD directly engaged with the University of Nebraska's Water for Food Institute about water-conservation and conducted interviews with media outlets including statewide news sources focused on progress and activities within the district. The district also actively updated its website to keep residents informed of activities. Civic leaders including mayors and managers of towns and villages within the district were informed of the district's use of a groundwater model to make water-use relocation decisions. The NRD described augmentation and other water management programs to members of the Legislature's Natural Resources Committee and University of Nebraska officials.

Middle Republican NRD shared information through its website and *Irrigation Leader* magazine.

Lower Republican NRD co-hosts the South-Central Nebraska Water Conference with Tri-Basin NRD and the Central Nebraska Public Power and Irrigation District to inform the

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public on the happenings of the water world within South Central Nebraska. NeDNR hosted a booth at this conference. All four NRDs produce newsletters for the public containing information about their activities, including water management activities in the Republican Basin. Lower Republican NRD also provides articles and radio publications on a regular basis to keep constituents informed. Lower Republican NRD conducted seven public meetings across the district where constituents were updated on plan progress, and the district held public meetings, called "Coffee with the NRD" throughout the district. Tri-Basin NRD also promotes its programs and policies through radio features on KRVN and promotes the NRD with a booth at county fairs and farm shows.

Each fall, NeDNR publishes an annual report to the Governor and Legislature, titled Annual Report and Plan of Work for the State Water Planning and Review Process. The report includes a section summarizing activities in the Republican River Basin for the prior fiscal year, as well as a four-year work projection for the basin. The report is available on NeDNR's website, *https://dnr.nebraska.gov*. NeDNR also annually submits a report to the Legislature each fall summarizing WRCF expenditures and accomplishments. Many of the projects described in the report are in the Republican River Basin.

3.1.3 *Educate civic leaders and the public about the policies and institutional infrastructure that contribute to the development and implementation of solutions*

NeDNR and the Republican Basin NRDs participated in education and outreach about policies and institutional infrastructure in 2023. The basin-wide plan identifies some examples of potential outreach topics related to this objective as correlative groundwater rights; integrated management plans; the *Republican River Basin-Wide Plan*; the Republican River Compact; other aspects of Nebraska's surface water and groundwater statutes; and other NRD rules, regulations, and plans. The following paragraphs provide specific examples of 2023 education and outreach activities related to the policies and institutional infrastructure that contribute to the development and implementation of solutions.

The NRDs and NeDNR communicate regularly with their legislative representatives and other state senators, as needed. Additionally, the Republican NRDs take turns hosting a basin focused banquet each January at the annual NARD Legislative Conference. The banquet is attended by state senators representing districts in the Republican Basin, NeDNR as well as NRD staff and board members.

The NRDs and NeDNR work to educate civic leaders and the public about the policies and institutional infrastructure that contribute to the development and implementation of solutions, through public outreach such as articles, conferences, radio news briefs, and public meetings. All four NRDs produce newsletters for the public containing information about their activities, some of which included articles about policies and institutional infrastructure in 2023. NeDNR produces a monthly podcast that is available on multiple platforms, and drought was the focus of the June 2023 episode.

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Upper Republican NRD held multiple conversations with members of the public during consideration and approval of the allocation reduction that included explanations of how policy is developed to achieve long-term district goals related to water conservation.

NeDNR and colleagues from Kansas and Colorado maintain a website with information about the Republican River Compact (*http://republicanriver.org/*), which includes background information about the RRCA, annual reports, and other RRCA meeting materials. Upper Republican NRD website is updated with Compact developments and provides a layman's explanation of the Compact and compliance efforts. Both Upper Republican NRD and NeDNR's websites include links to the Compact, the FSS, and other important Compact-related documents.

NeDNR and the NRDs also addressed these topics in 2023 at some of the other outreach events described under action item 3.1.2.

3.1.4 *Propose and support changes to laws, policies, and rules that would incentivize reduced water consumption*

N/A

In 2023 there were no proposed changes to laws, policies, and rules that would incentivize reduced water consumption within the Basin. NeDNR and the Republican River Basin NRDs are committed to evaluating all proposals that offer incentives to reduce groundwater use, with the intention of supporting any changes that do not reduce the economic vitality of the region in accordance with the mission of the Basin-Wide Plan.

A subcommittee of the Upper Republican NRD Board of Directors recommended a reduction in the 5-year allocation to conserve water, and the Board approved the reduction.

Obj. 3.2 Improve information sharing with water users who are reliant on the Basin's water supplies

3.2.1 *Share data and information related to the Republican River Compact with the public in an easily accessible, user-friendly format*

All four NRDs and NeDNR exchange water use and groundwater level data annually for RRCA accounting purposes. RRCA annual reports and final RRCA accounting data are available at *http://republicanriver.org/*, and RRCA groundwater model information is available at the RRCA's data site, *https://www.republicanrivercompact.org/*. Information about the Republican River Compact is also available on NeDNR's website and Upper Republican NRD's website. Resources available on Upper Republican NRD's website include the Compact itself, the 2002 Compact compliance settlement agreement, Compact accounting and reporting requirements, the 2015 U.S. Supreme Court ruling on Compact compliance, and information about projects designed to maintain Compact compliance. Some RRCA data are also available on NeDNR's INSIGHT (Integrated Network of Scientific Information & GeoHydrologic Tools) website (*http://nednr.nebraska.gov/INSIGHT/*).

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Middle Republican NRD shared data and information related to the Compact during a NRCS local work group meeting.

NeDNR and the NRDs have worked to make some data from the RRCA annual accounting and groundwater model more easily accessible and user-friendly by including data from these sources each year in the basin-wide plan annual report. NeDNR continues to work to improve the availability and format of RRCA data on this website.

3.2.2 *Annually prepare and exchange reports containing data and information about water supplies and uses in the Basin, and make these reports publicly accessible*

All four NRDs and NeDNR share data and information about water supplies and uses in the basin as part of the annual report for the basin-wide plan. This information is shared with the public at the basin-wide plan's annual meeting and through the *Republican River Basin-Wide Plan* website (*http://rrbwp.nebraska.gov*). NeDNR and the NRDs published the first and second annual reports in 2020, the third annual report in 2021, and the fourth report in 2022. Reports were first presented at the annual meeting (February 2020, November 2020, November 2021, and November 2022, respectively) and then published on the basin-wide plan website.

Lower Republican NRD also supports gathering information such as groundwater measurements with the United States Geological Survey and Nebraska Conservation and Survey Division. Information is publicized in annual reports. Lower Republican NRD further provides relevant water balance information at the South-Central Nebraska Water Conference.

Tri-Basin NRD and NeDNR also exchange information about water supplies and uses annually in fulfillment of the IMP for the Republican Basin portion of Tri-Basin NRD. These reports can be downloaded from the NeDNR website (*https://dnr.nebraska.gov*).

3.2.3 *Regularly communicate with the Plan's former Stakeholder Advisory Committee about implementation progress and potential Plan revisions*

All four NRDs and NeDNR work to keep former Stakeholder Advisory Committee members informed about implementation progress and potential plan revisions. This information is primarily shared at the annual meeting for the basin-wide plan.

Information about plan implementation is also shared via email through a GovDelivery contact list for people interested in receiving updates about the basin-wide plan. All stakeholders from the plan development process were added to the list when it was created. One former stakeholder does not have an email account, so printed copies of updates posted to the GovDelivery list are mailed to that individual.

Fifth generation IMPs for Upper, Middle, and Lower Republican NRDs became effective on September 27, 2021. Significant changes to the IMPs included an update to the in-state

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accounting equation used to assess NRD compliance, changes related to the Basin-Wide Plan (including a new goal), and updates related to changes in RRCA procedures.

At the time this report was published, Tri-Basin NRD and NeDNR are working on updating Tri-Basin NRD's IMP for those portions of Tri-Basin NRD located within the Republican River Basin.

Notification about the Basin-wide Plan annual meetings is provided on the NRDs' and NeDNR's websites, as well as the basin-wide plan website.

3.2.4 *Encourage and support water users to share information about their management practice improvements with other water users and the public*

All four NRDs and NeDNR encourage and support water users to share information about their management practice improvements with other water users and the public. In 2023, Upper Republican NRD, Middle Republican NRD and Lower Republican NRD provided annual water usage data to UNL from wells within the District. UNL aggregates the data and shares it with neighboring landowners so they understand how their water usage compares to usage in the immediate area.

Information sharing about water user management practice improvements is a standing agenda item for the basin-wide plan annual meeting.

NeDNR and the NRDs also supported and participated in UNL's Testing Ag Performance Solutions (TAPS) program, an annual competition that provides teams from all over the state with an opportunity to learn from each other about irrigation water management practices and other aspects of crop production. A substantial portion of past TAPS award winners has been from the Republican River Basin. All the NRDs have had district representation on TAPS teams who've won or placed in the top three of various categories across multiple TAPS competitions. A summary of Republican River Basin TAPS teams and winning TAPS teams from 2017 through 2023 is provided in Table 24.

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Table 24. Summary of Republican River Basin TAPS teams and Winning TAPS teams from 2017 through 2023.

NRD or other	Number of Teams	Number of Winning Teams
TBNRD	17	5
URNRD	12	5
MRNRD	45	12
LRNRD	27	4
Basin (NRD not specified)	2	1

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Goal 4	**When possible, pursue projects that not only benefit water supplies and uses, but also create benefits for fish, wildlife, recreation and conveyance within the Republican River Basin**
Obj. 4.1	**Where feasible and beneficial, protect and enhance fish and wildlife habitat and public outdoor recreational opportunities**

4.1.1 *Partner with wildlife-focused organizations on projects that benefit the organizations' habitat and wildlife interests while also helping to fulfill other goals of this Plan*

The Republican Basin NRDs continued to partner with wildlife-focused organizations on projects to benefit habitat and wildlife interests in the Basin in 2023. Upper, Middle, and Lower Republican NRDs conducted efforts through the N-CORPE Augmentation Project (N-CORPE) including public outreach, habitat improvement, and funding opportunities for improvements. N-CORPE partnered with UNL on a bat study and wildlife occupancy study. The NRDs also conduct tours of the N-CORPE property.

"Planting for Pheasants Forever" plantings are provided by Middle Republican NRD, and the District also participates in the NRCS Regional Conservation Partnership Program (RCPP) Nebraska Forest Service Project.

Lower Republican NRD continues to support Nebraska Game and Parks Commission (NGPC) through the lease of office space. Lower Republican NRD provides cost sharing on corners for wildlife.

Upper Republican NRD encouraged Southwest Weed Management District to fund tree, weed and brush removal at the Rock Creek Fish hatchery in Dundy County that is owned and operated by NGPC. The district worked cooperatively with NGPC to define the project scope. The project is intended to improve hatchery operations flow within Rock Creek, a tributary of the Republican River. The NRDs also provide support to the Twin Valley Weed Management and Southwest Weed Management Districts for the removal of invasive vegetation throughout the Basin, as described under Action Items 4.1.3 and 4.2.1.

4.1.2 *Promote public recreation on the river, when doing so can also help to fulfill other goals of the Plan*

In 2023 N-CORPE partnered with NGPC, Pheasants Forever, Visit North Platte, and North Platte Trails Committee to provide opportunities for public hunting; youth hunting; hiking. biking, and horse trails; and a seasonal Prairie Chicken blind. In addition, N-CORPE partnered with NRCS to provide outdoor safety training.

Lower Republican NRD supports NGPC through lease of office space. Through the Lower Republican NRD office, the NGPC provides public information regarding public recreation on open lands for recreation.

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4.1.3 *Cooperate in projects to assess and restore riparian wetlands while also helping to fulfill other goals of the Plan*

The NRDs provide financial support to weed management districts for the removal of invasive vegetation and noxious weeds throughout the Basin, including for restoration of riparian wetlands. Upper Republican NRD and Middle Republican NRD financially support the Southwest Weed Management District, and Upper Republican NRD is a board member of the Southwest Weed Management District and actively engaged in selection of projects to clear riparian areas of undesirable vegetation. Lower Republican NRD financially supports the Twin Valley Weed Management District. The NRDs have also worked with the weed management districts on projects across the basin to restore riparian areas, providing funding and time toward the projects.

Through Lower Republican NRD's financial support of the Twin Valley Weed Management district which eradicates invasive and noxious weeds along the Republican River, both native and desirable species are provided restoration opportunity to succeed as riparian wetlands rather than forested, shrubbed, or palustrine wetlands.

Obj. 4.2 Where feasible and beneficial, reduce the effects of undesirable vegetation on water conveyance

4.2.1 *Cooperate in removing undesirable vegetation impacting water conveyance and managing reinfestation*

As described under Action Item 4.1.3, the NRDs provide financial support to the Southwest and Twin Valley Weed management districts for the removal of invasive vegetation and noxious weeds throughout the Basin. Upper Republican NRD has a representative on the board of the Southwest Weed Management District and is actively engaged in selection of projects to remove undesirable vegetation to improve streamflow. Lower Republican NRD financially supports the Twin Valley Weed Management district which eradicates invasive and noxious weeds in the Republican River Basin.

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Assessment of Measurable Hydrologic Objectives (MHOs)

Under *Neb. Rev. Stat.* § 46-755 (4)(b), this basin-wide plan is required to include measurable hydrologic objectives (MHOs) to ensure that reasonable progress is being made toward achieving the goals and objectives of the plan. The basin-wide plan includes five MHOs, which are each evaluated either annually or every five years, as specified in the basin-wide plan. The MHOs and their assessment schedules are summarized in Table 25. Results of the MHO evaluations are described beginning on page 65.

In the table summarizing the results of each MHO, possible results of the assessment are described, including whether the results indicate that further discussion is required or not. If a result indicates that discussion of next steps is required, this means that NeDNR and the NRDs will discuss the test results and determine what actions will be taken to achieve the MHO in the future, as described in the basin-wide plan.

Table 25. Measurable Hydrologic Objectives (MHOs) agreed to during plan development and adoption. During plan implementation, each MHO is to be evaluated either annually or every 5 years, as specified in the basin-wide plan.

Measurable Hydrologic Objective (MHO)	Evaluation Frequency
MHO A: Maintain each NRD's net groundwater depletions to streamflow within its portion of Nebraska's allowable groundwater depletions to streamflow	Annually
MHO B: Limit groundwater depletions to streamflow to a relatively constant level over the long-term both across the basin as a whole and within each NRD	Every 5 years, beginning in 2023
MHO C: Ensure there is always enough groundwater for all groundwater uses within the timeframe of this plan, either by stabilizing groundwater levels or managing declining groundwater levels	Every 5 years, beginning in 2023
MHO D: Continue existing and initiate new actions that reduce the need for special regulations in the Rapid Response Area for Compact compliance	Annually
MHO E: Continue existing and initiate new actions that reduce the need for administration of surface water use for Compact compliance	Annually

MHO A Evaluation

MHO A Assessment Criteria

MHO A is to maintain each NRD's net groundwater depletions to streamflow within its portion of Nebraska's allowable depletions to streamflow. For the purposes of MHO A, "net groundwater depletions to streamflow" includes augmentation and other management actions.

The basin-wide plan defines the MHO A assessment as follows: for the previous Compact averaging period (2 or 5 years, as determined by Compact accounting procedures), has each NRD's net groundwater depletions to streamflow for the RRCA model area remained within its portion of Nebraska's allowable

groundwater depletions to streamflow, as specified in the IMPs? This MHO is being achieved if the answer to that question is yes for each NRD. The results of this assessment are described in the next subsection.

The MHO A assessment as described above applies only to Upper Republican, Middle Republican, and Lower Republican NRDs, because these are the three NRDs that receive a portion of Nebraska's allowable groundwater depletions to streamflow as defined and under the terms of their IMPs. The equivalent test from the IMP for the Republican Basin portion of Tri-Basin NRD is the hydrologically balanced assessment, which evaluates whether Tri-Basin NRD's depletions from groundwater pumping exceeded accretions from the groundwater mound caused by seepage from Platte River canals within in the district, when calculated on a three-year rolling average basis. The results from that analysis are included below, beginning on page 66.

MHO A Evaluation Results for 2023

MHO A evaluation results are summarized in Table 26. For 2023, MHO A is being achieved for Upper Republican, Middle Republican, and Lower Republican NRDs. Each NRD's groundwater net depletions to streamflow remained within its portion of Nebraska's allowable depletions to streamflow, as specified in the IMPs. The evaluation and results for each NRD are described below the summary table.

Table 26. Summary of MHO A results for 2023.

Key to Possible Test Results	 MHO is being achieved. NRD's actual depletions were within its allowable depletions. No further discussion is needed.  MHO is not being achieved. NRD's actual depletions exceeded its allowable depletions. Discussion of next steps is required.		
NRD	**Upper Republican**	**Middle Republican**	**Lower Republican**
NRD's Results for 2023			

According to the Compact accounting procedures, the averaging period applicable to 2023 is five-year averaging.

Allowable groundwater depletions to streamflow for each NRD are defined in the *Monitoring & Studies Technical Memorandum for the URNRD, MRNRD, and LRNRD IMPs*. Each NRD's groundwater depletions to streamflow is calculated using the RRCA groundwater model. An NRD's net depletions are the sum of groundwater depletions and the impacts to Nebraska's Compact balance from management actions taken.

Altogether, the difference between an NRD's allowable groundwater depletions to streamflow and the NRD's groundwater net depletions to streamflow is equivalent to the average of the NRD's annual balances over the appropriate averaging period where an annual balance is calculated as:

*(Nebraska Allocation + Nebraska Credits – $SWCBCU_{NE}$ – Other NRD CBCU – All NRD Management Actions) * NRD's Applicable Baseline Depletion Percentage – NRD GwCBCU + NRD Management Actions*

The results of the five-year average evaluation for MHO A for 2023 for each NRD are shown in Table 27. Two-year averaging was not evaluated this year as part of MHO A because, under RRCA Accounting Procedures, two-year averaging does not apply for 2023.

Table 27. MHO A evaluation results for 2023, with five-year averaging. Positive values indicate that allowable groundwater depletions to streamflow exceeded actual groundwater net depletions to streamflow. The five-year averaging period for MHO A is evaluated based on the average of the evaluation year (2023) and the previous four years, in conformance with RRCA Accounting Procedures.

	Difference between allowable depletions and actual groundwater net depletions (acre-feet)		
Year	**Lower Republican NRD**	**Middle Republican NRD**	**Upper Republican NRD**
2019	40,262	46,951	65,758
2020	14,844	28,487	26,335
2021	2,229	12,180	12,577
2022	-6,947	2,063	-7,059
2023	-9,364	-2,802	-5,702
5-year average (2019–2023)	**8,205**	**17,376**	**18,382**
5-year average positive?	**Yes**	**Yes**	**Yes**

Tri-Basin NRD Hydrologically Balanced Assessment Results for 2023

The hydrologically balanced assessment from the IMP for the Republican Basin portion of Tri-Basin NRD evaluates whether Tri-Basin NRD's depletions from groundwater pumping and accretions from the mound are hydrologically balanced when calculated on a three-year rolling average basis. This assessment is performed by NeDNR each fall, following finalization of RRCA data for the prior calendar year.

Hydrologically balanced assessment results for 2023 are summarized in Table 28. The analysis and results are explained below the summary table.

Table 28. Summary of results of hydrologically balanced assessment for Tri-Basin NRD for 2023.

Key to Possible Test Results	 In compliance with IMP. On a three-year rolling average basis, depletions from groundwater pumping did not exceed accretions from the mound. Also, sufficient management actions were taken in 2023 to offset net depletions from previous year's test, if any. No further discussion is needed.  Caution. On a three-year rolling average basis, depletions from groundwater pumping exceeded accretions from the mound. Under the terms of the IMP, management actions are required to maintain a hydrologically balanced condition. Discussion of next steps is required.  Insufficient management actions were taken in 2023 to offset net depletions from previous year's assessment. Discussion of next steps is required.
Tri-Basin NRD's Results for 2023	

Full details of the hydrologically balanced assessment for 2023 are included in NeDNR's report for the IMP for the Republican Basin portion of Tri-Basin NRD, titled *2023 Annual Report of 2022 Data by the Nebraska Department of Natural Resources to Meet the Requirements of the Integrated Management Plan for Those Portions of the Tri-Basin Natural Resources District within the Republican River Basin*. The three-year average net effect is positive for 2023 (Figure 15), meaning that mound accretions exceeded groundwater depletions from pumping on a three-year average basis; therefore, no offsets are required in the future as a result of the 2023 test. In addition, no management actions were required to be taken by Tri-Basin NRD in 2023 to offset the results of a previous year's test.

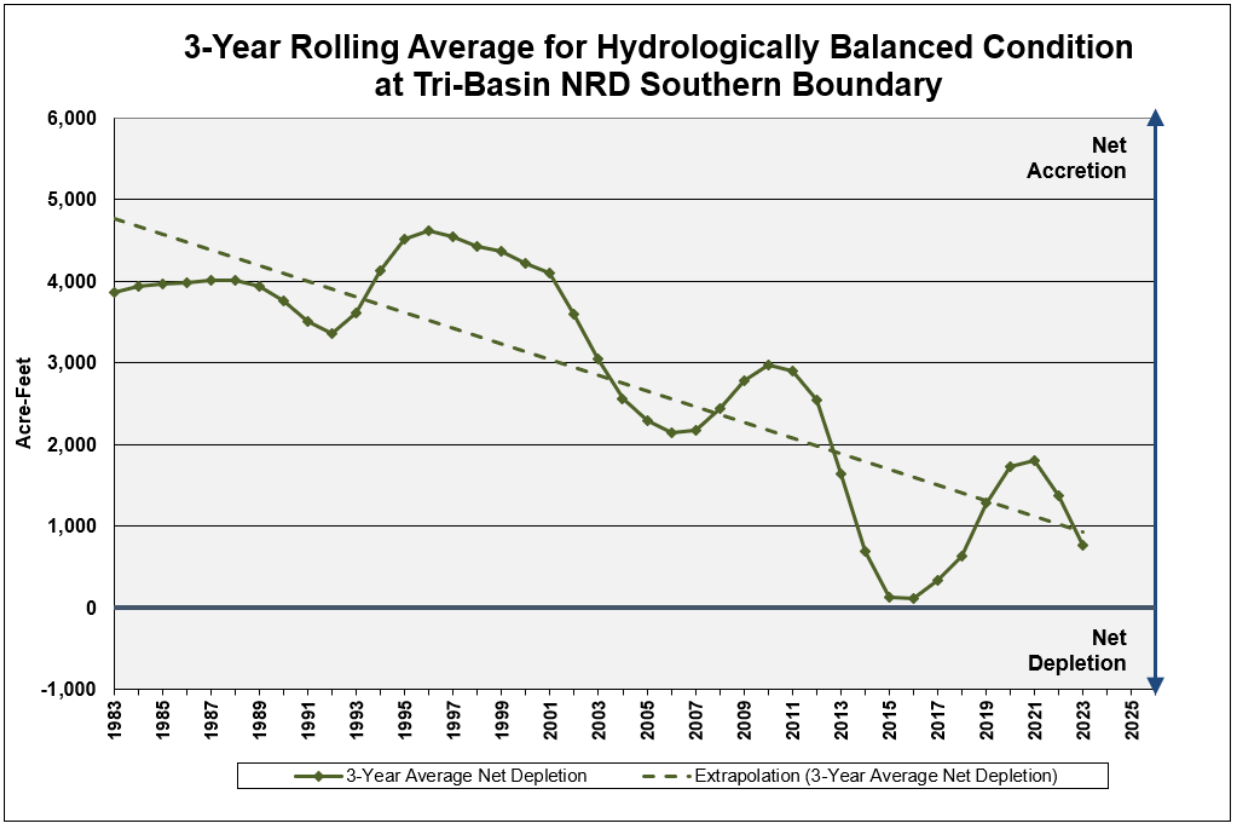

Figure 15. Rolling three-year average net effect to baseflow as the total of modeled values of streamflow depletion and mound accretions, using the August 2020 RRCA Accounting Procedures and the RRCA groundwater model.

MHO B Evaluation

MHO B is evaluated every five years as part of the basin-wide plan's five-year technical review. No MHO B evaluation is required this year. The next five-year technical analysis will be completed in 2028.

MHO C Evaluation

MHO C is evaluated every five years as part of the basin-wide plan's five-year technical review. No MHO C evaluation is required this year. The next five-year technical analysis will be completed in 2028.

For additional information about the next phase of evaluation for MHO C, see the text in this report under Action Item 1.3.2, ***MHO C***.

MHO D Evaluation

MHO D Assessment Criteria

MHO D is to continue existing and initiate new actions that reduce the need for special regulations in the Rapid Response Area for Compact compliance.

The basin-wide plan defines the MHO D assessment as follows: during the previous year, has groundwater pumping within the Rapid Response Area of any NRD been curtailed to ensure Compact compliance? This MHO is being achieved if the answer to that question is no for each NRD. The results of this assessment are described in the next subsection.

Note that this assessment only applies to Upper Republican, Middle Republican, and Lower Republican NRDs. The IMPs for those NRDs state that in Compact Call Years, if management actions taken by the NRD are insufficient to ensure compliance, the NRD will implement additional ground water controls and regulations to make up for any expected shortfall, which will include curtailment of groundwater pumping within the Rapid Response Area (10 Percent/5-Year Area) of the NRD. The purpose of this MHO is to ascertain whether such curtailment occurred.

MHO D Evaluation Results for 2023

MHO D evaluation results are summarized in Table 29. For 2023, MHO D is being achieved for Upper Republican, Middle Republican, and Lower Republican NRDs, as none of the NRDs curtailed pumping within the Rapid Response Area in 2023 to ensure Compact Compliance.

Table 29. Summary of MHO D results for 2023.

Key to Possible Test Results	 MHO is being achieved. NRD did not curtail groundwater pumping within the Rapid Response Area to ensure Compact compliance. No further discussion needed.  MHO is not being achieved. NRD curtailed groundwater pumping within the Rapid Response Area to ensure Compact Compliance. Discussion of next steps is required.		
NRD	**Upper Republican**	**Middle Republican**	**Lower Republican**
NRD's Results for 2023			

MHO E Evaluation

MHO E Assessment Criteria

MHO E is to continue existing and initiate new actions that reduce the need for administration of surface water use for Compact compliance.

The basin-wide plan defines the MHO E assessment as follows: During the previous year, has surface water use within the basin been administered to reduce surface water use to ensure Compact compliance? This MHO is being achieved if the answer to that question is no. The results of this assessment are described in the next subsection.

Note that for the purposes of MHO E, only surface water administration that occurs to fulfill Nebraska's Compact obligations as described in the IMPs for Upper Republican, Middle Republican, and Lower Republican NRDs is included. Surface water administration that is required by the terms of the FSS is

excluded from MHO E. For more information, see "Surface Water Administration for Compact Compliance."

MHO E Evaluation Results for 2023

MHO E evaluation results are summarized in Table 30. For 2023, MHO E is being achieved, as surface water use within the basin has not been administered for Compact Compliance. For further details, see "Surface Water Administration for Compact Compliance."

In October 2023, Kansas requested administration of 1,860 acre-feet of Remaining Compact Compliance Volume (RCCV) from 2016. The water was administered into the Kansas irrigation supply in Harlan County Lake in late 2023 during the non-irrigation season. The RCCV balance was zero at the end of 2023. MHO E was achieved in 2023 because surface water was not administered for Compact Compliance (no irrigators were shut down during irrigation season), and the RCCV was water generated through NRD management actions.

Table 30. Summary of MHO E results for 2023.

Key to Possible Test Results	MHO is being achieved. NeDNR did not administer surface water to ensure Compact compliance, except as required under the FSS. No further discussion needed. MHO is not being achieved. NeDNR administered surface water to ensure Compact Compliance. Discussion of next steps is required.
Results for 2023	

Figure 16. Republican River, photo courtesy of Tri-Basin NRD.

Feasibility Analysis of Water Markets in the Republican River Basin

Background

As required by Neb. Rev. Stat. § 46-755(1), a basin-wide plan (Plan) for the Republican River Basin (Basin) was jointly developed by the Nebraska Department of Natural Resources (NeDNR) and the Natural Resources Districts (NRDs) in the Basin including the Upper Republican NRD, Middle Republican NRD, and Lower Republican NRD, and Tri-Basin NRD (collectively, Basin NRDs). This Plan became effective on March 1, 2019. The Plan is required by Neb. Rev. Stat. § 46-755(4)(b) to maintain Nebraska's compliance with the Republican River Compact (Compact); an interstate agreement which apportions the waters of the Basin between the states of Colorado, Nebraska, and Kansas.

During the development of the Plan, stakeholders expressed interest in determining the feasibility of establishing a water market in the Basin. Stakeholders stated that a potential water market could incentivize conservation of water with the intended outcome of reducing overall consumptive use. These goals were incorporated into the Plan as Objective 2.6.

Objective 2.6 of the Plan is to "Evaluate the feasibility and potential outcomes of establishing water markets in the Basin." The two action items described below indicate how this goal is to be achieved.

Action Item 2.6.1: Cooperate in determining the feasibility of water markets in the Basin.

The feasibility analysis will include such considerations as:

- Compact compliance obligations,
- Program costs,
- Regulatory framework, and
- Water user interest.

Action Item 2.6.2: Following the water markets feasibility analysis (Action Item 2.6.1), test conclusions through implementation of a water market program in a pilot area, if feasible.

This report describes results of the feasibility analysis of a potential water market in the Basin which was completed by NeDNR and the Basin NRDs to fulfill Action Item 2.6.1. This analysis included reviewing literature on existing water markets and their feasibility and conducting an interest survey of key water users in the Basin. Information gathered in the literature review was used to evaluate water market feasibility in the context of existing conditions in the Basin. The criteria outlined in the analysis were largely borrowed from *Rapid scoping for water market readiness (*Brozović, 2021), which lists a diverse range of criteria for water market feasibility. Results of the interest survey are included — sufficient participation of water users is a key factor in water market feasibility.

What is a Water Market?

A water market is a platform for trading water rights where the price is determined by market conditions and the trades occur based on supply and demand. There are three types of water trading: **1)** short-term transfers of water that is available for immediate use; **2)** medium-term leasing of water allocations in a manner that enables a water user to plan their use for a period of time; and **3)** permanent transfer of water rights. Water markets can be one of the more complicated economic instruments to design (Wheeler et al., 2017). Regarding water rights, Nebraska has distinct systems of allocation and regulation for surface and groundwater. Under constitutional and statutory provisions, surface water flows are allocated in accordance with the prior appropriation doctrine. Groundwater, in contrast, is governed by the doctrine of correlative rights and the Ground Water Management and Protection Act.

Conditions for Water Market Feasibility

Severity of Water Risk

The severity of water risk is a factor in water market feasibility. The higher the risk to reliable water supply, the more market demand might exist for additional water rights.

Prevalence of drought is a water risk because it leads to a combination of decreased supply and increased demand for water. Lower total precipitation, decreased streamflow, shortfalls in reservoir storage, and higher rates of evaporation decrease available water supplies. Simultaneously, drought and the accompanying heat reduce soil moisture and increase crop water demands. When demand for water exceeds supply, water rights can be curtailed. In a system that is overappropriated, junior water rights may not be filled even in wet years. Groundwater use may also be curtailed due to aquifer depletion.

The Basin has a limited water supply, is naturally semi-arid, and undergoes regular cycles of drought. Surface water in the Basin was determined to be fully appropriated, Neb. Rev. Stat. §§ 46-715(1)(a) and 46-755(1), which required the Basin NRDs to develop Integrated Management Plans (IMPs; see Figure 1) and a basin-wide plan (Plan). Groundwater users in much of the Basin are subject to allocation (see IMPs for each Basin NRD, included in *References* section below), limiting the amount of water they can use in a given time period. Users of both surface water and groundwater in the Basin are at risk of having their rights curtailed to maintain compliance with the Compact. Surface water users may see their rights curtailed through administration to comply with Compact requirements, and groundwater users in hydrologically connected areas may see their rights curtailed as well. These factors constitute the presence of water risk in the Basin.

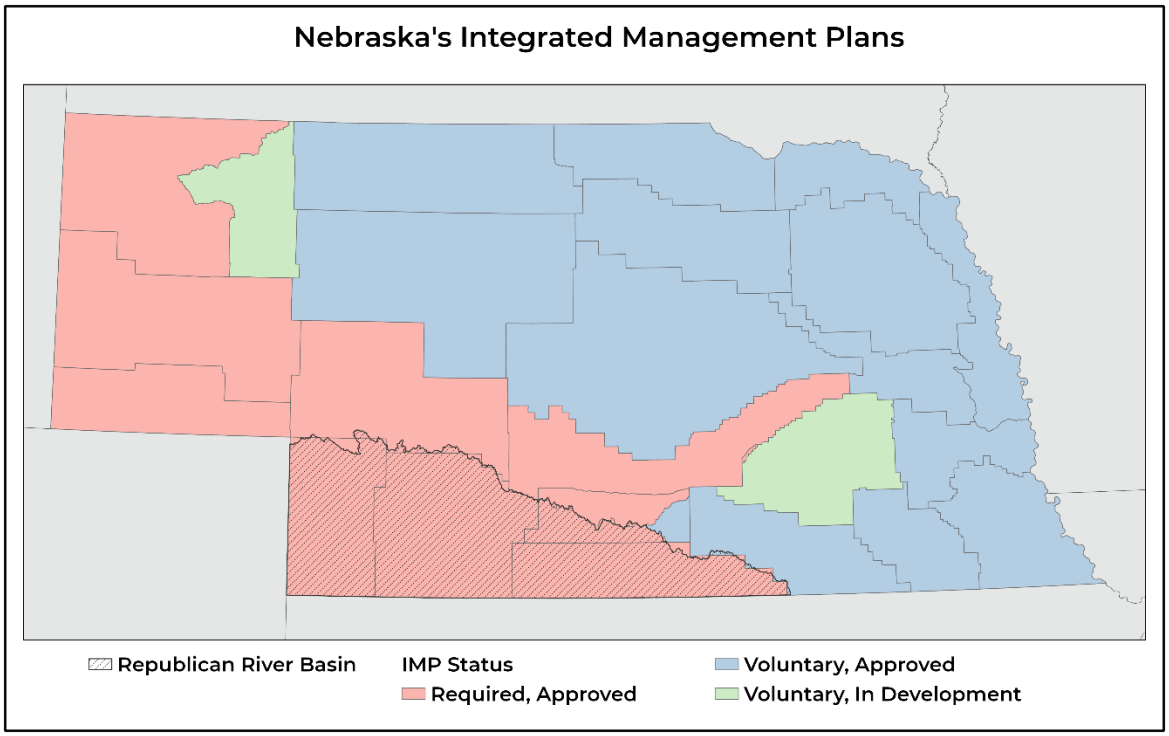

Figure 1. IMP status of Nebraska NRDs. Based on map available here.

Legal Readiness

Water markets can only be established in areas where there is legal readiness, i.e., the local regulations and statutes governing water use allow them. Assuming the water system in question has restricted water use in the form of quantified water rights, the main concern becomes the permissibility of water rights transfers. For a short-term water risk such as drought, allowing the temporary transfer of water rights is an important factor in legal readiness. Transfers between similar water uses (groundwater to groundwater or surface water to surface water) might be relatively simple, but still subject to limitations and restrictions to prevent injury to other water users, conserve groundwater in water-short areas, reduce impacts to stream flow, and other criteria determined by NRDs. By contrast, transfers between different types of water use (groundwater to surface water or surface water to groundwater) can be more complicated and restricted.

Any water market implemented in the Basin cannot injure the ability of the State of Nebraska to comply with its obligations in the *Final Settlement Stipulation (FSS)* of the Compact. Chapter III of the FSS places a moratorium on new wells in most of the Basin upstream of Guide Rock, Nebraska, with some exceptions. Any transfers of rights or permits for wells cannot use more water than the historic consumptive use. There are also limitations to issuing new permits for surface water rights, and all members of the Republican River Compact Administration (RRCA) must be notified in advance of any new permitting. Nebraska's water allocation must undergo special administration during a Water-Short Year.

Each Basin NRD has its own rules and regulations regarding the transfer of groundwater rights. Tri-Basin NRD allows the transfer of groundwater, including outside of the NRD. Upper Republican NRD allows transfer of groundwater only within divisions called floating townships unless they are from an area of higher stream depletion to an area of lower stream depletion. The URNRD Board of Directors will consider transfers outside of floating townships and when doing so evaluate multiple variables; approval of such transfers are often subject to special conditions imposed by the board. Transfers within a township to an area of higher stream depletion must be offset by a reduction in allocation. Middle Republican NRD allows transfers of groundwater with limitations based on internal differences in allocation. Permanent transfers are not allowed during a Compact Call Year (CCY). Lower Republican NRD does not allow transfer of groundwater or changes in location of groundwater use unless it is on acres contiguous with the donor tract (see Rules and Regulations for each Basin NRD, included in *References* section below).

Transfers of surface water rights are permitted with limitations, for example, they cannot diminish the supply available to any other water appropriator. If there are any surface water users with a point of diversion within one mile downstream of a transfer applicant's point of diversion, a waiver of objection must be obtained from the downstream user(s) if there are no tributaries between them which could provide adequate supply. If the land currently under appropriation is in an area determined to be fully or over appropriated, the land currently under appropriation cannot be irrigated with groundwater after the transfer (*457 Neb. Admin. Code Chapter 9, § 001.03F*). The potential for surface water rights to be administered for Compact compliance purposes complicates the availability and reliability of surface water rights within the Basin.

The presence of these local, state, and interstate regulations and restrictions on both groundwater and surface water are legal barriers to the feasibility of a water market.

Administrative Readiness

Administrative readiness for water markets requires a strong monitoring and enforcement regime and efficient review of transfer applications. Without adequate resources devoted to the review of transfer applications by the body administering water use, an efficient water market would not be able to function, since water leases are time sensitive. The transfer application and review process should not require the hiring of professional staff or high administrative fees such that it would make small water transfers prohibitively expensive.

The Basin has a strong system of monitoring and enforcement of water rights. State law and the Compact require comprehensive monitoring of consumptive water use and enforcement of water rights. Reservoir levels are monitored. Irrigation wells are metered, some of them remotely. Surface water use is closely monitored. Transfers of groundwater allocation must go through an approval process with their respective NRD. Transfers of surface water would be subject to Neb. Rev. Stat. §§ 46-290-295. Transfers of any type moving further than transferring to adjacent lands would be subject to a number of reviews; field investigation to verify that the water right is not subject to cancellation, a review of the historical consumptive use, analysis of the "loss" associated with the transfer, mapping, publication of the proposed transfer, hearing(s) if there are objectors, and finally a ruling by the director.

If these types of transfers were to become common, or if in the early phases of the project there were a high volume of transfer applications, it is possible that NeDNR would need to hire additional staff to deal with the workload; this would include field staff to conduct investigations, program staff to process the applications, and perhaps even legal resources to conduct hearings.

Heterogeneity of Water Values

Heterogeneity of water values is a key driver of the demand for and participation in a water market. Significant spatial differences in the value of irrigation water create the incentive for transferring water rights during periods when water is in short supply.

There is spatial difference in the value of center pivot irrigated land vs dryland with irrigation potential within the Basin. The University of Nebraska (UNL) releases a comprehensive report on farmland values annually. The report divides the state into eight regions, with the Basin lying in the southern and southwestern regions. The report indicated the difference in value between land that could be irrigated and land that was irrigated by center pivot was higher in the southern region than the southwestern (Figure 2).

Region	Southwest	South
Dryland Cropland with Irrigation Potential ($/acre)	2,130	4,745
Center Pivot Irrigated Land ($/acre)	5,340	8,685
Difference	3,210	3,940

Figure 2. 2024 Nebraska Farmland Values and Cash Rental Rates, University of Nebraska. (Jansen & Stokes, 2024)

A 2018 study from the Daugherty Water for Food Center estimated the value generated by irrigation in the High Plains Aquifer region on a county level. The study used an estimate of the additional production generated by irrigation and compared it to local 2007 crop prices. The study found the gross value of irrigation water to be between $200-250 per irrigated acre in most counties within the Basin, with a value above $250 per irrigated acre in two counties. This finding suggests the additional value generated by irrigation is relatively uniform across the Basin, and relatively similar to values in southwestern Nebraska as a whole (Perrin et al., 2018).

Demand inelasticity can contribute to heterogeneous water values between water users. For example, water values can differ between perennial and annual crops. Perennial crops, such as fruit trees and vines, can take years to mature, their water demand is less elastic during times of acute water scarcity, because producers cannot forgo irrigation without losing their investment. Producers of annual crops could choose to forgo growing an irrigated crop during a time of high demand and sell or lease their water rights. In the Basin, there are virtually no perennial crops which could serve as inelastic sources of water demand for others to trade with. As shown in figures 3 and 4, a map and pie chart of crop types generated from the USDA Cropland Data Layer, most land area consists of grassland, or annual crops such as corn, soybean, wheat, and others.

A possible contributor to inelastic water demand is the tendency of producers to follow crop rotations in order to maintain soil health and high crop productivity. For example, the Nebraska Corn Board reported that planted acreage of corn in the state has been relatively consistent at approximately 10,000,000 acres for more than a decade, despite price fluctuations. This may indicate that producers prefer to stay in rotation, rather than plant whichever crop would produce the greatest market value per unit of water employed at the time.

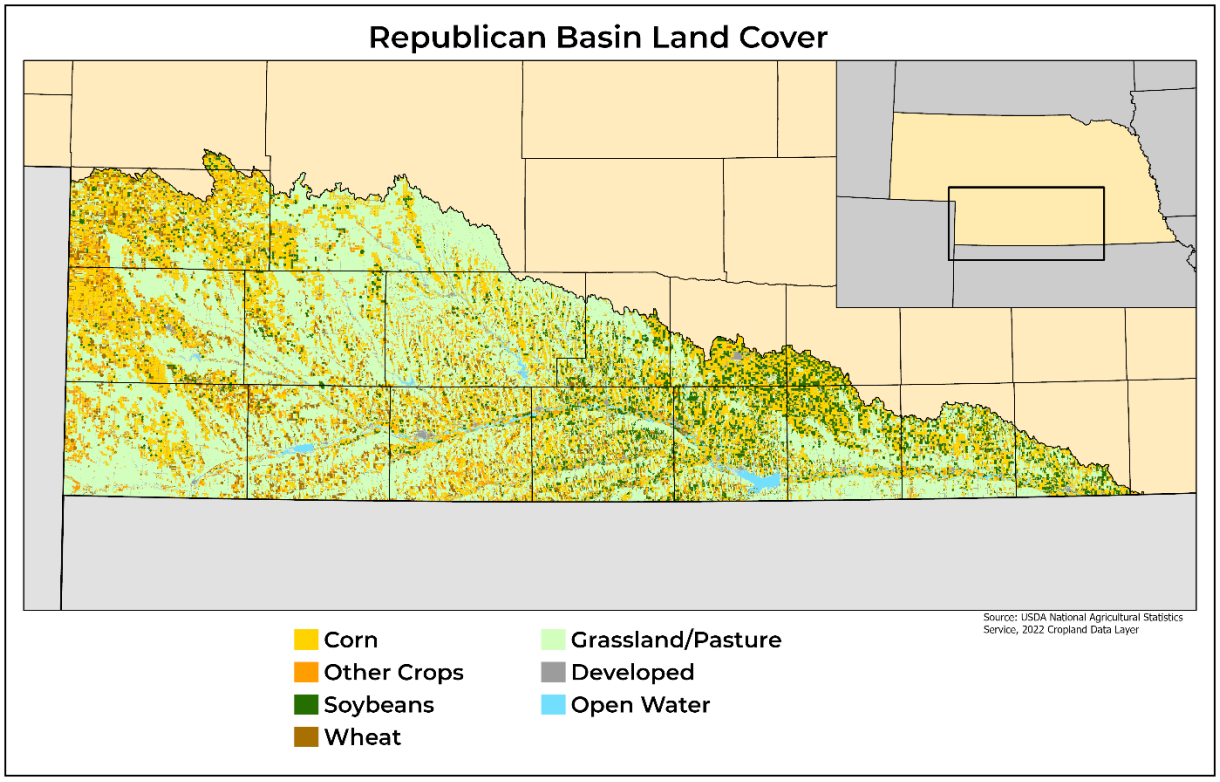

Figure 3. Source: USDA National Agricultural Statistics Service, 2022 Cropland Data Layer.

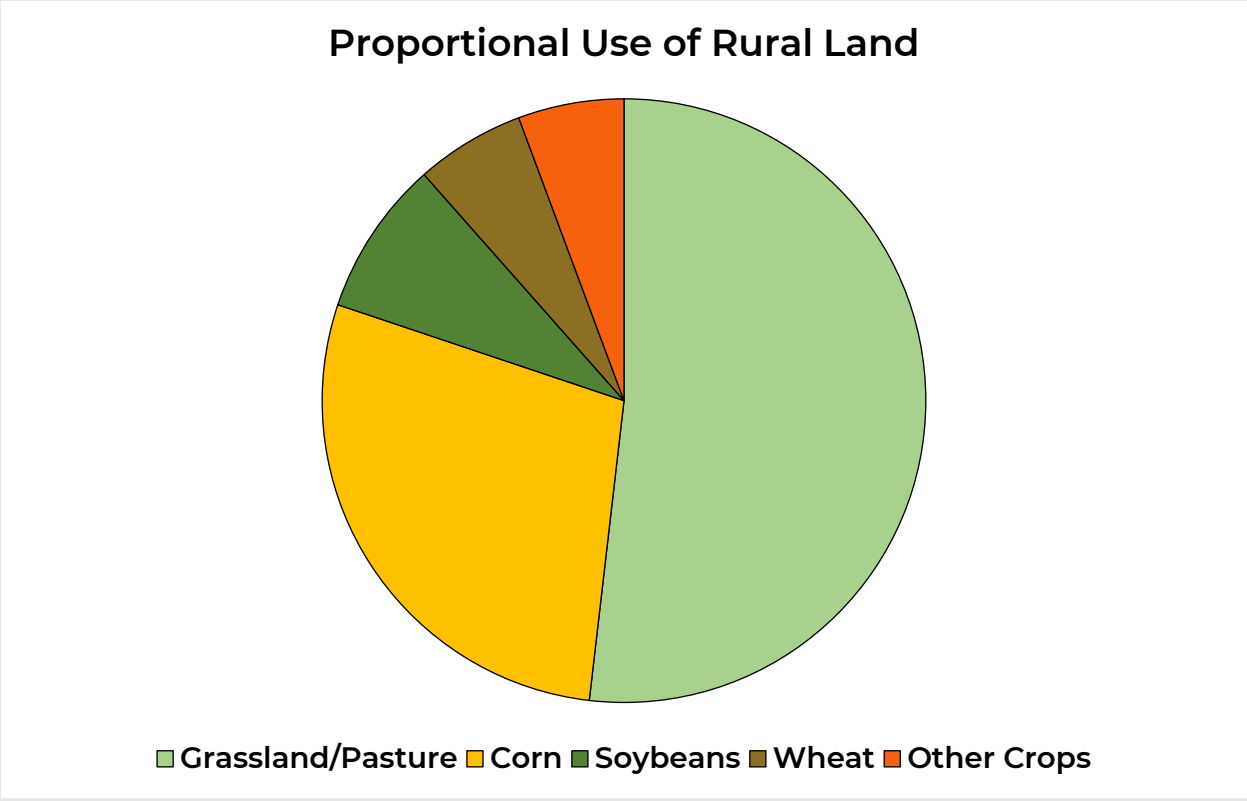

Figure 4. Source: USDA National Agricultural Statistics Service, 2022 Cropland Data Layer

Infrastructure Readiness

A comprehensive and efficient distribution system is needed for a water market to function. Without a canal and distribution system serving enough water users there cannot be a market for surface water. Likewise, groundwater users who wish to trade allocations must have the necessary well and distribution systems. Constructing new water conveyance systems can take a long time and is generally cost-prohibitive.

The Basin has a well-developed system of irrigation canals to deliver surface water to appropriators. There are four active irrigation districts, seven private canals, and 225 individual surface water irrigation pumps within the Basin. Reservoirs and dams used by irrigation districts are routinely inspected by the NeDNR division of dam safety. There are many monitored groundwater irrigation wells in the Basin, as well as rural and municipal water supply systems. The presence of these systems demonstrates infrastructure readiness for a potential water market.

Survey Results

In May of 2023, NeDNR and the Basin NRDs, in conjunction with the UNL Public Policy Center (PPC), conducted a survey of Basin stakeholders to determine interest in water markets (Appendix A). The survey asked participants to describe the nature of their water use, their knowledge of water markets, and their interest in a potential water market.

In total, 21 of those surveyed responded. Their responses were compiled in a report (Appendix B). The majority of survey participants were primarily groundwater users. Expressed familiarity with water markets varied widely among the respondents. The majority of survey participants (55%) were not willing to support a potential water market in the Basin, while one third (35%) were willing to do so. An additional group (10%) was undecided. Half of those surveyed (50%) believed a water market would increase the consumption of water in the Basin, another half (50%) believed a water market would have no effect on the consumption of water. None of the respondents (0%) believed that a water market would decrease the use of water within the Basin.

Respondents to the survey were allowed to leave written comments regarding their thoughts and recommendations for a water market. Multiple commenters expressed doubt that a water market was legally feasible. They also expressed concern that a water market would create a financial incentive to consume more water by providing additional value to unused or underused water rights. Commenters who seemed more favorable to the idea of a water market emphasized that it should be transparent and tested in a small area before being expanded.

Examples of Real-World Water Markets

Central Platte NRD Groundwater Exchange Program, Nebraska

Central Platte NRD is located in the Platte River Basin. In 2016 a formal, NRD-run groundwater market was piloted. Called the "Groundwater Exchange Program", it established a virtual market for the temporary leasing of rights to irrigate. Due to the constraints involved with transferring water within the NRD, a consultant, National Economic Research Associates (NERA), was hired to create a trading platform. The platform NERA created could check each trade for compliance with NRD regulations and accept or reject the trade. Some regulations placed on trades by the NRD included:

- No adverse effect on streamflow
- No moving water west
- No net transfers from one Groundwater Management Area to another

The program was extended through the 2017 growing season but was ended afterwards due to a relative lack of willing buyers for water. The program cost $105,000 with NeDNR cost sharing 50%.

Diamond Valley Groundwater Market, Nevada

The Diamond Valley is a small basin in central Nevada overlying an isolated aquifer (Figure 5). The area is home to about 26,000 acres of irrigated land, mostly cultivated hay and alfalfa (Nevada, 2019). Being in an arid region, the groundwater recharge rate is naturally low, and pumping has severely depleted the water table (Zeff et al., 2016). The rate of groundwater depletion in the valley had long been the concern of the Nevada State Engineer, who regulates water use in the state.

In 2015, the state engineer declared the valley a "Critical Management Area." Under Nevada law, this empowered the state engineer to curtail consumptive use of groundwater by irrigators to a sustainable level, requiring a decrease by as much as 64% (Zeff et al., 2016). Water users in the basin were given 10 years to develop and support a Groundwater Management Plan to reach a sustainable level of water use and remove the Critical Management Area designation. Nevada groundwater rights are based on prior appropriation. If water users were unable to agree on a plan, the state engineer would begin sharply curtailing water rights based on strict priority. This would leave most junior rights holders completely cut off and even some domestic wells would be restricted (Nevada, 2019).

Most water users eventually agreed to support a Groundwater Management Plan which would establish a groundwater market in the Diamond Valley. Under the plan, an annual allocation for the basin was created and divided into shares, with shares being distributed according to a formula which acknowledged seniority. This allocation and the resulting shares would be reduced by an increment each year until the amount reached a level considered sustainable by the state engineer (Nevada, 2019). Shares of the allocation can be used, traded, sold, or banked for future use. The goal is to create an incentive to conserve water by giving monetary value to parts of their allocation that water users can save, while drawing down the total consumptive use of the entire basin.

Some senior water right holders have objected strongly to the Groundwater Management Plan, arguing that it violates their legal right to prior appropriation. They argue that the state is responsible for over appropriating the basin and they are being unfairly injured for the actions of the state and junior water users. Others have argued the plan takes too long to lower allocations, allowing over-pumping to continue for decades (Rothberg, 2019). Some water users challenged the validity of the Groundwater Management Plan in court, appealing it to the Nevada Supreme Court. In June 2022, the court ruled that the plans in areas that are losing groundwater quickly can deviate from prior appropriation (Stern, 2022).

Encouraging water users to trade water rights among themselves is not the only strategy the state of Nevada has taken to reduce groundwater overuse. In 2023, the Nevada Legislature granted $15 million in funding to allow local water authorities to purchase and permanently retire groundwater rights in the basin on a voluntary basis. The program, called the “Voluntary Water Rights Retirement Program”, saw more applicants than it had funding. If all sales go through, about 30% of the Diamond Valley groundwater yield will be retired (Solis, 2024).

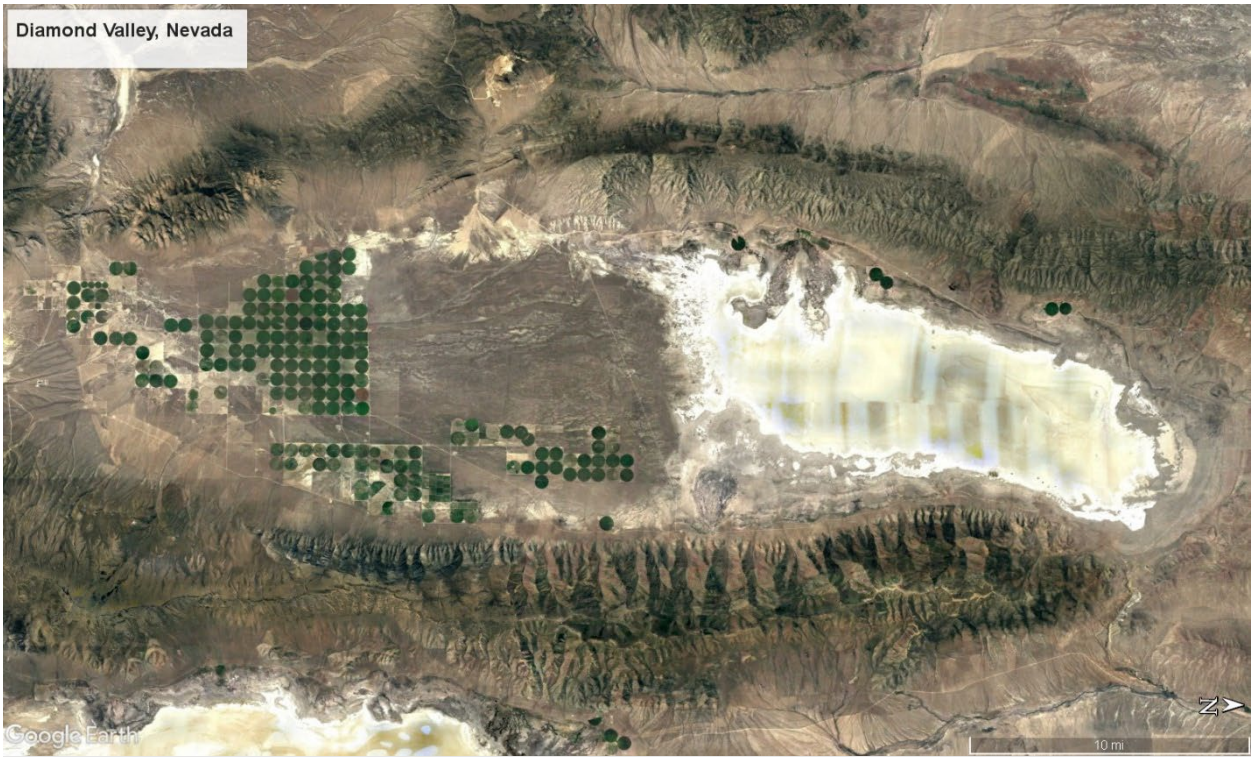

Figure 5. Diamond Valley, Nevada. Source: Google Earth, Landsat.

Murray-Darling Basin, Australia

The Murray-Darling Basin extends across four states in southeastern Australia, comprises over 1 million square kilometers (386,000 square miles), and has a population of approximately 2 million. The basin generates 40% of Australia's agricultural income and accounts for three quarters of irrigated land within Australia (Crase et al., 2004). The basin has one of the most mature and well-developed water markets in the world. Surface statutory water rights are defined in diversions per irrigation season (Grafton et al., 2012).

In the 1980s it became apparent that surface water had been overappropriated and there was a push to separate these water rights from the land they were attached to. This development began the establishment of water markets (Grafton et al., 2012). Key to the success of the water market was the agreement of states within the basin to make water rights exclusive, divisible, tradable, and recorded in public registers. Some state governments allowed the trading of water rights across state borders. However, entitlement and allocation systems differ by state, and this has made trading across state borders difficult (Crase et al., 2004). Multiple public water exchanges exist which function as public notice boards and sometimes as clearinghouses to facilitate trades of water rights. Various irrigation districts exist in the basin – trading is also restricted for reasons such as hydrological limitations to water movement and the environmental impact of changing water supply and use patterns (Qureshi et al., 2009).

Permanent water products are referred to as entitlements – these are generally divided into high security, general security, and low security classes (Seidl et al., 2020). Temporary water products are referred to as allocations – there are allocations for surface water and groundwater. There are also leases, from 1-5 years, and carry-over space (parking/water forwards) from 1-5 years (Seidl et al., 2020). Some states in the basin allow carry-over, others do not. Most employ some mix of higher and lower security rights, with high security entailing a mostly guaranteed annual quantity, and lower security being filled based on available supply.

The temporary trading of water rights is much more common than permanent trading (Qureshi et al., 2009). A hard cap was placed on extractions in 1995. The cap was set at a level where rights exceed actual long-term availability. Scarcity created a financial incentive to use previously unused water rights, driving down actual supply (Grafton et al., 2012). Those with higher marginal use value of water buy from those with lower marginal use value. One large beneficiary of trading is perennial crop producers (e.g., orchards, vineyards), who whose crops would have potentially died if they were not able to secure water through the market.

Some financial entities hold water rights as an investment. Environmental groups have also purchased water rights for the purpose of conservation and providing water to wildlife. The share of water rights held by non-landowners was estimated at 12% (Seidl et al., 2020). This trading of water by non-landowners as well as the increased liquidity of water rights as a private property right have led to the basin's water markets being increasingly used as a stock market.

Conclusion

Following a review of scientific literature on the nature of water markets, analyses of water markets throughout the world, and a survey of stakeholder interest, NeDNR and Basin NRDs do not plan on conducting a water market pilot program. Such a program was determined to be infeasible due to the following reasons:

- Statutory and Compact compliance barriers such as limitations on transfers and consumptive use.
- Limited interest from Basin stakeholders as determined by the interest survey.
- Limited interest in and discontinuation of an NRD-wide groundwater market in a different basin.
- Unclear case for water conservation.

While some factors in the Basin which would be conducive to a basin water market were identified through this analysis, significantly more limiting factors which would make a basin water market infeasible were also identified. One such factor is that the legal constraints on transferring water rights in the Basin are complex and would increase transactional costs. Basin stakeholders also expressed limited interest in a potential water market, and none expressed a belief that one would lead to a decrease in overall water use. A formal groundwater market in a different Nebraska basin similarly received little participation and was closed. Real-world examples of water markets studied did not show clear evidence they are effective for reducing overall water use. None of the real-world examples of water markets were similar enough to the Basin that their success could be an argument for establishing one there.

Water rights are closer in nature to real estate than a security. They are cumbersome to trade and traded infrequently, with buyers and sellers thinking in terms of years when making decisions. Trades that do occur within the Basin are often arranged through real estate agents or small markets such as a single canal system or areas within an NRD. It is possible that this organic market activity satisfies all the demand within the Basin. This status quo is a viable alternative to a pilot program under Action Item 2.6.2.

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Attachment E

Republican Basin: Compact Call Year Decision Timeline

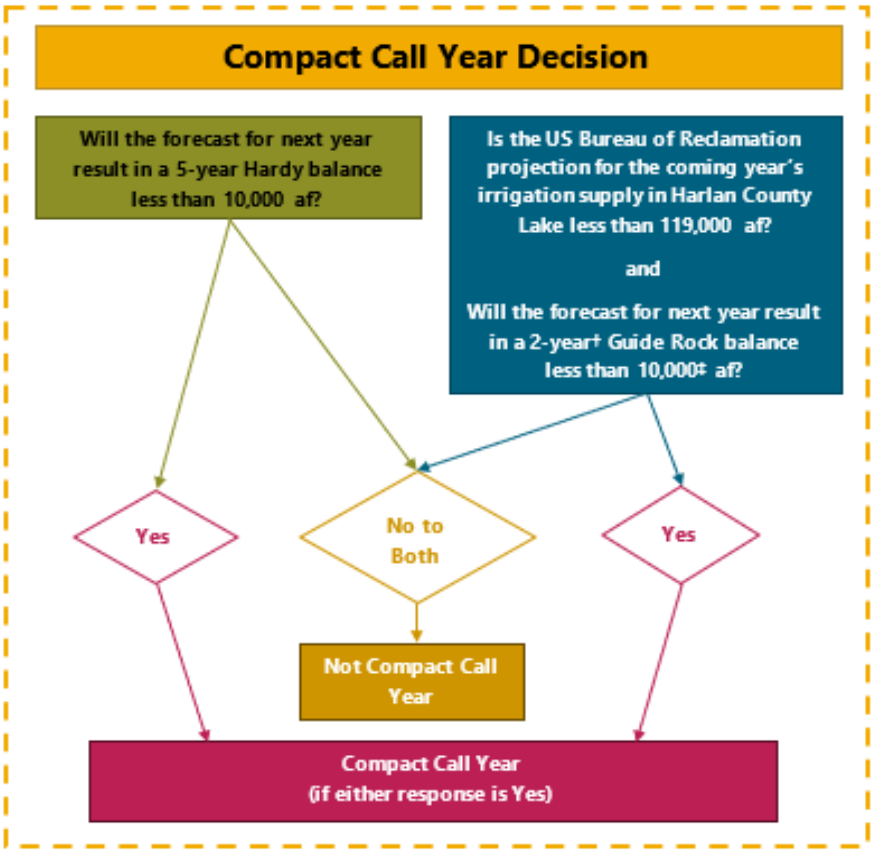

Figure 1. Compact Call Year Decision

What is a Compact Call Year?

A Compact Call Year (CCY) is a year in which Nebraska Department of Natural Resources' (NeDNR) analysis indicates Nebraska may not be in compliance with the Republican River Compact (Compact) unless additional management actions are taken. Forecast procedures are in the *Monitoring & Studies Technical Memorandum for the URNRD, MRNRD, and LRNRD IMPs* (*Memorandum*). The CCY process decision-making procedure is illustrated in the figure to the left.

In a CCY, Nebraska must take additional action to meet its Compact obligations by reducing consumption or generating additional streamflow. This occurs through regulatory or non-regulatory actions; possible groundwater management actions are outlined in the NRDs' Integrated Management Plans (IMPs). For groundwater, the NRDs may need to establish more restrictive, temporary allocations and curtail groundwater pumping in the Basin. For surface water, NeDNR may need to regulate and administer surface water in the Basin.

What is a Forecast?

A forecast is the calculation of the maximum amount of water that may be available from streamflow for beneficial use in the short-term and long-term, while maintaining compact compliance. NeDNR follows the procedures in the *Memorandum* and determines the forecast for the 5-year balance at Hardy and the 2-year balance at Guide Rock.

What is a Water-Short Year?

A Water-Short Year is a year in which the projected or actual irrigation water supply in Harlan County Lake is less than 119,000 acre-feet. This projection is calculated by the US Bureau of Reclamation (Bureau) using methodology described in the *Harlan County Lake Operation Consensus Plan*, one of the documents approved by the US Supreme Court for management of the Republican River Basin. The final Water-Short Year calculation is done in July, using data collected from January through June of that year. The Bureau provides the three Compact states (Colorado, Kansas, and Nebraska) with monthly updates of the projected or actual irrigation supply from Harlan County Lake.

Republican Basin: Compact Call Year Decision Timeline

How does NeDNR use the forecast and Water-Short Year determination to decide if the following year will be a Compact Call Year?

The Compact Call Year decision process is depicted in Figure 1 and the procedures are in the *Memorandum*. Information NeDNR uses to make the decision includes:

- The 5-year forecast for the balance at Hardy, calculated by NeDNR (green box in Figure 1)
- Water-Short Year determination from the Bureau (top of blue box in Figure 1)
- The 2-year forecast for the balance at Guide Rock, calculated by NeDNR (bottom of blue box in Figure 1)

A Compact Call Year will be triggered if:

1. The 5-year forecast for the balance at Hardy is less than 10,000 acre-feet, **AND/OR**
2. There is a Water-Short Year **AND** the 2-year† forecast for the balance at Guide Rock is less than 10,000‡ acre-feet. [†If it is beneficial to use the Alternative Water-Short Year Plan provisions from the Final Settlement Stipulation (i.e., if the previous two years have a greater balance than the last year alone), and if an Alternative Water-Short Year Plan has been approved by the RRCA, then substitute "3-year" for "2-year" in the Guide Rock test. ‡In the second consecutive Compact Call Year, the 10,000 acre-feet threshold for the Guide Rock test will be reduced to 5,000 acre-feet. For the third and subsequent consecutive Compact Call Years, this value will be reduced to zero.]

What happens if there is a Compact Call Year?

1. **December:** NeDNR notifies the NRDs in writing that the following year will be a Compact Call Year and notifies the NRDs how much yield from potential management actions may be needed within the CCY.
2. **January:** The NRDs notify NeDNR in writing about planned management actions to ensure Compact compliance.
3. **January:** NeDNR issues orders to implement surface water controls.
4. **late February or early March:** NeDNR provides a written assessment of the NRDs' planned management actions. If NeDNR determines that proposed management actions are insufficient to ensure compliance with the Compact, the IMPs, or the Republican River Basin-Wide Plan, the NRDs will implement additional controls to make up the remaining deficit.
5. **April:** NeDNR notifies Colorado, Kansas, and relevant federal agencies in writing about preliminary management actions and the anticipated water yield.
6. **May:** NeDNR provides preliminary accounting estimates to the NRDs, Kansas, Colorado, and the Bureau (this occurs monthly from May through December).
7. **June:** NeDNR notifies Colorado, Kansas, and relevant federal agencies in writing about management actions taken and to be taken, and the anticipated water yield.
8. **June 30:** Bureau finalizes Water-Short Year designation.
9. **Prior to October 1:** Nebraska and Kansas review accounting; Kansas can request remaining Compact compliance volume (RCCV).
10. **September-October**: NeDNR notifies the NRDs in writing about the assessment of NRD management actions and identifies specific additional management actions that are required by each NRD.

If you have questions about the Compact Call Year process, please contact Sam Capps, NeDNR, at 402-471-0376.