Minutes

Fifth Annual Meeting
Republican River Basin-Wide Plan

In-Person: Holdrege, NE
Virtual: Zoom
November 15, 2023
1:00 P.M. Central Time

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Attendance

24 people were in attendance. Those that signed in or attended virtually are listed below.

Meeting Participants

Nebraska Department of Natural Resources (NeDNR):

Alexa Davis (NeDNR)

Avery Dresser (NeDNR)

Brian Flynn (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)

John Thorburn (Tri-Basin NRD)

Nate Jenkins (Upper Republican NRD)

Nick Simonson (Lower Republican NRD)

Sasha Hahn (Tri-Basin NRD)

Todd Siel (Lower Republican NRD)

Other Attendees:

Brad Edgerton (Frenchman-Cambridge Irrigation District)

Carrie Wiese (Olsson Engineering)

Dale Helms (Surface and Groundwater Irrigator)

Douglas Wing (Stakeholder)

Dustin Wilcox (Nebraska Association of Resources Districts)

Eric Umbreit (Rubicon Water)

Kole Pederson (NE Farm Bureau)

Kurt Mantonya (University of Nebraska-Lincoln Public Policy Center)

Michael Archer (Nebraska Game and Parks)

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. 17 people attended in person and 7 attended online.
2. Plan implementation progress – Sam Capps

    A draft of the annual report (*Fifth 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). References to the purpose and location of each section in the report were provided.

    a. Annual Report: Plan Implementation Progress 2022 – 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 management actions were taken for 2022 Compact compliance.
            3. Next year 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. URNRD reduced its allocation in 2023 Allocation was reduced from 13 inches per year to 12.5 inches per year, a decrease from 65 inches to 62.5 over a five-year allocation period. The allocation is now slightly below the minimum irrigation requirement for corn in the local area. Many irrigators have unused carryforward balances which could be used to deficit irrigate. In recent years, URNRD has limited the amount of carryforward which can be withdrawn to 7.5 inches per allocation period. These limits have reduced the amount of carryforward irrigators are willing to use on an annual basis.

ii. 2022 was one of the three driest years on record. Average irrigation water use was 16 inches. Jenkins commented that average use was surprisingly low, given how dry 2022 was. For example, in 2012, a similarly dry year, average irrigation use had been 18.5 inches. Limits on carryforward use was a likely explanation for lower overall use in 2022.

iii. URNRD has been installing telemetry meters. Close to half of all meters in the district, approximately 1,500, are now telemetry meters. The impact of these telemetry meters on water use should appear in the coming years. The meters can be helpful in guiding irrigation scheduling and maximizing efficient use.

iv. URNRD is combining evapotranspiration data with water use data from telemetry meters to help irrigators make more efficient irrigation decisions. Research shows the information can reduce water use by 10-15%. URNRD plans to launch an online portal for irrigators to access this information within a couple of months.

v. Jenkins noted that research suggests irrigators tended to use less water voluntarily when they were aware of the real time effects of pumping on their electric utility bills.

b. Middle Republican NRD (MRNRD) – Jack Russell

i. MRNRD did not change its allocation in 2022. It remains 12 inches. The MRNRD Board had changed district rules and regulations to allow no more than 12 inches of carryforward. If that carryforward is used at the end of an allocation period, it is not deducted from the following irrigation period.

ii. MRNRD had producers sign an agreement saying they understood the rules and regulations of the district as part of an effort to promote knowledge of the rules and regulations.

iii. The district is installing telemetry meters and replacing whole meters, as the meters are district property. 80% of the district is covered by telemetry meters, approximately 1,900 in total. Complete installation is expected within a year. MRNRD has found that a water savings of 3-5% occurs once telemetry meters are installed. With soil moisture probes and evapotranspiration data, a savings of 7-10% is possible.

iv. MRNRD was successful in leveraging a large amount of funding to complete irrigation efficiency and water sustainability projects. The district has spent approximately 20 million dollars over the last five to six years on projects. The ability to leverage funding has greatly increased the impact that the district has in managing water.

c. Lower Republican NRD (LRNRD) – Todd Siel

i. LRNRD has not changed its allocation since 2008. It is 9 inches per year, 45 inches over the five-year allocation period, and up to 9 inches can be carried over into the next 5-year period (2023-2027). There is a hard cap of 13 inches of irrigation for any year that is designated by NeDNR as a Compact Call Year.

ii. The district is working on a telemetry meter project which started about seven weeks ago. Less than 100 meters have been installed so far; there are slightly more than 3,000 meters in the district. Telemetry meters will likely be installed at a rate of 95% across the district.

iii. Last year, irrigation water use across the district was 9.87 inches, this year's use is trending lower and will likely be approximately 8 inches. 92% of irrigation meters have been read so far this year.

iv. Precipitation trends were flipped, with the western part of the district receiving more water than expected, and the eastern part of the district being unusually dry.

v. Siel mentioned the projects LRNRD was undertaking such as the Flag Creek Augmentation Project and proposed Platte-Republican Diversion. These were discussed in more depth later in the meeting.

d. Tri-Basin NRD (TBNRD) – John Thorburn

i. Thorburn noted that 2022 had been a dry year and there had been some brush fires in the district.

ii. The district's average water use was 12.97 inches in 2022. 2023 had been a wetter year. Yield reports from producers were disappointing. Water use would likely be around 7 inches for 2023 but was not final.

iii. TBNRD has one township with an allocation, which is 27 inches over 3 years. This allocation remained unchanged. Because of the 2022 wildfires going through the township, irrigators were

given a temporary holiday from the allocation to allow crops to be established. TBNRD also has a voluntary allocation program called the Water Conservation Incentive Program (WCIP). Irrigators accept an allocation in exchange for flexibility over which acres they irrigate.

iv. Thorburn noted that the proposed Platte-Republican Diversion had won a judgement in the State Supreme Court regarding the standing of complainants.

e. NeDNR – Sam Capps

i. 5-Year Technical Analysis

1. This year was the first year that MHOs B and C were reported on. The 5-Year Technical Analysis is a statutory requirement of the Republican River Basin-Wide Plan (Plan) under *Neb. Rev. Stat.* § 46-755(5)(d). Requirements include:

a. Available supplies, current uses, and changes in long-term water availability.

b. Effects of conservation practices and natural causes including, but not limited to, drought.

c. Effects of the plan in sustaining a balance between water uses and supplies.

2. The report will go to the Nebraska Legislature in early 2024. The final report will be posted on the NeDNR website.

2. Measurable Hydrologic Objectives (MHOs) (page 62 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 62 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 2022.

ii. MHO B and C (page 66 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 completed and reported on; wells identified as having statistically significant

downward trends require further analysis conducted by NeDNR and the NRDs.

iii. MHO D (page 68 of Annual Report) – MHO D was achieved for 2022 in all the Republican NRDs. No portion of the rapid response area is part of the TBNRD.

iv. MHO E (page 69 of Annual Report) – Surface water was not administered in the URNRD, MRNRD, and LRNRD to ensure Compact compliance; MHO E was achieved.

b. 5-Year Technical Analysis – Avery Dresser

i. The main focus of the analysis was the MHOs, especially MHOs B and C. An analysis of lag time was also performed, analyzing the delay of pumping impacts to streamflow.

ii. The Analysis was conducted using RRCA approved data from 2019-2022 (period of analysis). Due to the timing of Plan implementation, four years of RRCA approved data were included in the first analysis. Analyses moving forward will include five years of data (e.g., 2023-2027).

iii. Based on the Analysis, no modifications to the Plan were needed.

iv. Dresser explained that MHOs are objective indicators of hydrologic status. They are used as a benchmark of progress towards the goals of the Basin-Wide Plan.

1. MHO A: "Maintain each NRD's net groundwater depletions to streamflow within its portion of Nebraska's allowable groundwater depletions to streamflow". This MHO was met by all NRDs for all years during the analysis period, including TBNRD based on a 3-year average of net effect to streamflow at the southern boundary. There is a downward trend in TBNRD's net accretion to streamflow at the southern boundary.

2. 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". This MHO was met by all NRDs. Groundwater depletion trends were analyzed using the Mann-Kendall Trend Test. The timeframe analyzed was 2008-2022 for UR, MR, and LRNRDs and 2013-2022 for TBRND. The test was run multiple times with depletions datasets decorrelated for precipitation, baseflow, and virgin water supply. TBNRD's depletions were evaluated including the groundwater "Mound Credit".

3. 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". Average spring groundwater level trends were analyzed using the Mann-Kendall Trend Test. The timeframe analyzed was 2008-2022 for UR, MR, and LRNRDs and 2013-2022 for TBRND. Areas near the Rock Creek and Nebraska Cooperative Republican Platte Enhancement (N-CORPE) augmentation projects were excluded from the analysis.
    a. Wells with a statistically significant decreasing trend which would leave groundwater levels below the bottom of the well by the end of the Plan (2044) were highlighted for further analysis. Three wells were identified.
    b. Dresser stated that NeDNR and the NRDs would need to proceed with analysis of those wells within two years, as described in the methodology for MHO C.
4. MHO D: "Continue existing and initiate new actions that reduce the need for special regulations in the Rapid Response Area for Compact Compliance". This MHO was met by all NRDs. None of the NRDs curtailed groundwater pumping within their Rapid Response Areas during the period of analysis. TBNRD does not have a Rapid Response Area.
5. MHO E: "Continue existing and initiate new actions that reduce the need for administration of surface water use for Compact Compliance". This MHO was met during the period of analysis. Any administration automatically triggered under the terms of the Final Settlement Stipulation (FSS) was not included.

v. Analysis of Streamflow Depletion Lag Time

1. The RRCA groundwater model was used to analyze impacts of past pumping on future streamflow depletion by projecting the lagged effects of past pumping.
2. Historical data through 2022 were used for past pumping, projections of future streamflow depletions were made to the year 2221, with the assumption that all pumping ceased in 2022.
3. Four projections were made using high, average, low, and cyclic precipitation inputs.
4. The analysis concluded that lagged depletions would decrease rapidly for 10-20 years, then be relatively stable for the next 100

years. Depletions would still remain 200 years after pumping stopped.

vi. Available Water Supplies, Current Uses, and Long-Term Availability

1. Dresser presented a table showing the difference between Nebraska's allocation under the Compact and its consumptive use offset by imported water supply. The difference was shown to be positive during the period of analysis.
2. No overall trend in long-term water availability was identified in the basin.
3. The only local trend identified was the decrease in TBNRD's groundwater mound accretion.
4. Siel asked how non-federal reservoir evaporation was calculated. Burgert replied that net evaporation for the non-federal reservoirs was calculated using net evaporation rates from the nearest federal reservoir. Helms noted a large number of small, non-federal reservoirs exist upstream of Harlan County Lake.

vii. Effects of Conservation Practices

1. A literature review of conservation practices was being performed as part of the first five-year technical analysis. This part of the analysis was not finished at the time of the Annual Meeting.
2. Dresser reported an important finding of the literature review; conservation tillage can lead to an increase in infiltration and a decrease in runoff in the short-term but can increase baseflows in the long-term.

viii. Conservation Programs Implemented During Analysis Period

1. Dresser presented a list of conservation programs undertaken by the NRDs and NeDNR during the analysis period. Some of these programs had already been mentioned by NRD managers earlier in the meeting.
2. Programs undertaken included voluntary irrigation reductions, remote sensing, improved irrigation efficiency, groundwater mapping and modeling, and canal efficiency improvements.
3. Siel asked Jenkins how URNRD calculated water savings for their voluntary irrigation reductions. Jenkins replied that he could not recall exactly, but it was based on historical irrigation averages.

ix. Effects of Natural Causes on Water Supplies and Uses

1. The Basin is affected by cycles of drought and flooding. There was a large variation in precipitation during the analysis period.

x. Effects of the Plan on Water Balance and Progress Made

1. Avery stated that the Plan has been effective, it has aided in maintaining Nebraska's Compact compliance. Nebraska appears to be maximizing the beneficial use of water to the highest practical extent.
2. No management actions or offsets were needed during the analysis period.

c. Feasibility and Potential of Planned Projects – Various Stakeholders

i. Platte Republican Diversion Application – John Thorburn

1. The project is now 8 years old. A water right for the diversion project had been applied for in 2018 and re-applied for in 2019. There have been multiple hearings on the project. Multiple objectors had their objections dismissed for lack of standing by the State Supreme Court. NeDNR will proceed with reviewing the water right application. The proposed water right would always be junior to all Platte Basin water rights.
2. If the water right for the project is approved, work will commence on obtaining easements for the diversion site, final design, and permits from Nebraska Department of Transportation (NDOT) for a pipeline.
3. Siel noted that the flooding in June of 2023 was a good example of a time when the Platte would have been able to contribute flows to the project. Thorburn stated that up to 10,000 acre-feet could have been captured if the project had been completed before then.
4. Helms asked if the flows that could be contributed by the project would count as imported water; Thorburn replied that they would.

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

1. The purpose of the project is to keep more water in Harlan County Lake. 2022 was a design phase for the project. There will be more details available at a later date.

iii. Natural Resources Conservation Service (NRCS) Watershed Grants & Flag Creek Project – Todd Siel

1. LRNRD has two ongoing NRCS Watershed and Flood Prevention projects. They were given a one-year extension by the NRCS in 2023 and are due to complete the projects in March 2024. The projects are

taking slightly longer than expected. The project originally investigated reservoir storage but switched to diversions and augmentation as potential methods of providing improved agricultural water management. If a diversion structure was created, the US Bureau of Reclamation (USBOR) and either Frenchman-Cambridge Irrigation District (FCID) or NBID will be involved in the development of the design and operation.

2. The Flag Creek project is a small augmentation project which can augment Harlan County Lake. Two wells have currently been drilled. Siel said a pump test was expected within a few weeks. LRNRD's consultant will test capacity and conveyance of water to the Republican River.

iv. FCID Canal Efficiency Project – Brad Edgerton

1. In 2022, FCID finished automation of the Meeker-Driftwood Canal System. This included a system called "Total Canal Control" (TCC), which allows canal operators to remotely monitor and direct canal flows in real time. Cambridge Canal has TCC as well. Operating in TCC allows FCID to realize water savings by eliminating the water loss during the time it took to travel to diversions and physically open and close them.
2. In 2022, FCID drew a large volume of water for irrigation. This led to reduced water available for irrigation in 2023. Cambridge Canal operated with an allocation of 8 inches, Bartley Canal operated with 6 inches, and Meeker and Red Willow Canals were not operated due to lack of water. There were significant runoff events in spring 2023 which have helped the reservoirs recover somewhat.

d. Water Market Feasibility Study – Stefan Remund

i. A study of water market feasibility and a survey of key stakeholders' interest in water markets was done to fulfill Action Item 2.6.1: "Cooperate in determining the feasibility of water markets in the basin". (Note: During the creation of the BWP, stakeholders stressed that any potential water market should support water conservation and the decrease of consumptive use. A summary of the water market discussion is available in Appendix G of the BWP.)

ii. Remund explained that a water market is a platform for short- or long-term trading of water rights. He highlighted findings for water market feasibility; for example: The legal readiness for water markets in the Republican Basin is questionable due to restrictions on moving groundwater rights and irrigated acres. The presence of homogenous

crop types in the basin likely indicated water use values would not vary enough between locations to provide a powerful incentive for trade.

iii. Key stakeholders in the basin were surveyed by the University of Nebraska Public Policy Center (PPC) to gauge their interest in water markets. The majority of respondents were not in favor of supporting the establishment of a water market in the basin. Some stakeholders did express interest while others expressed concern over increasing water use and the legal feasibility of a water market. None of those surveyed believed a water market would decrease water consumption.

iv. Examples of water markets in the real world were studied. It was found that there was wide variety in the size and structure of water markets. None of the markets studied showed both success by the priorities of the Plan and an applicability to the Basin.

v. Remund concluded that piloting a new water market did not appear feasible. There were already small markets for water within the basin, key factors for feasibility of new markets were not present, and stakeholders did not express adequate interest.

e. Drought Exercise Report – Elizabeth Esseks ("Drought Exercise Report," Attachment D).

i. The Drought Planning Exercise was part of Plan action item 2.8.1: "Organize and participate in a basin-wide drought planning exercise"; the exercise took place in May 2022.

ii. It was found that existing policy appears adequate for managing water quantity, drought should be treated like a disaster, and communication among stakeholders is important.

iii. The Drought Planning Exercise participants recommended developing a drought plan consisting of provisions for communication in drought emergencies, an online dashboard to provide access to real-time drought conditions, and a list of potential projects to improve resiliency or response to drought.

iv. The report will be posted on the Republican River Basin-Wide Plan website.

v. Siel asked when a drought dashboard could be expected; Esseks responded that development would probably begin once NeDNR had finished other projects.

3. Collaboration

a. Existing and potential new water conservation programs

i. Capps reviewed existing decertification programs.

ii. Thorburn further elaborated on the WCIP program he described earlier.
    1. WCIP is a voluntary TBNRD program which incentivizes water conservation practices among irrigators. The program has three options:
        a. A five-year allocation program for groundwater users. The main benefit to producers of accepting a limit on how much they can pump is that they can irrigate acres that are not certified. There is a monetary incentive of $4 to $5 per acre-inch for saving water.
        b. An option for co-mingled water users which incentivizes the use of canal water instead of groundwater whenever possible by reimbursing irrigation district fees.
        c. A recently approved option is to suspend irrigated acres on an annual basis to allow temporary changes in land use, such as solar panel installations.

        This program has about 1,860 acres enrolled, with the district having budgeted for 8,000 acres of total enrollment. There are about 4,400 co-mingled acres enrolled.
    2. There were no new sign-ups this year.

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. Thorburn mentioned that TBNRD is hosting the South-Central Water Conference on February 1st, 2024. Thorburn thanked Alexa Davis for her assistance with Water Jamboree and Rainwater Basin Conservation Days.

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 implementation of the Plan.
    b. No conflicts were submitted for consideration prior to this meeting.
5. Public comment
    a. There was general discussion but no public comments.
    b. Capps offered to send copies of the 5-Year Technical Analysis Report to anyone who wanted one, once they were available. Edgerton replied that he would like one.
    c. Capps mentioned the Compact Call Year handout ("Republican Basin Compact Call Year Decision Timeline," Attachment E) as a resource since 2024 will likely be a Compact Call Year.

Attachment A

2023 Annual Republican Basin-Wide Plan Annual Meeting

November 15, 2023 | Holdrege, NE | 1:00 p.m. (CST)

SIGN-IN SHEET

	Name:	Representing (Self or Organization):
1.	Avery Dresser	NeDNR
2.	John Thorburn	Tri-Basin NRD
3.	Sam Capps	NeDNR
4.	Elizabeth Esseks	NeDNR
5.	Brian Flynn	NeDNR
6.	Stefan Remund	NeDNR
7.	Todd Siel	LRNRD
8.	Brad Edgerton	FCID
9.	Nate Jenkins	URNRD
10.	Jack Russell	MRNRD
11.	Alex Boyce	MRNRD
12.	Jennifer Schellpeper	NeDNR
13.	Dale Helm	Surface Water and Groundwater Irrigator
14.	Kaii Burger	NeDNR
15.	Zole Pederson	NE Farm Bureau
16.	Douglas R. Wing	Self
17.		
18.		
19.		
20.		

Attachment B

Fifth Annual Meeting
Republican River Basin-Wide Plan

Wednesday, November 15, 2023
1:00 pm Central Time (12:00 pm Mountain Time)

Tri-Basin Natural Resources District Office
1723 Burlington Street
Holdrege, 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 2022
        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)
    b. 5-Year Technical Analysis
    c. Feasibility and potential impacts of planned projects
    d. Water market feasibility study
    e. Drought planning exercise report
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

Fifth Annual Report for the Republican River Basin-Wide Plan

Data and Progress Updates, 2022

Presented at the Annual Meeting

November 15, 2023

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 2022 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 2022. 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.

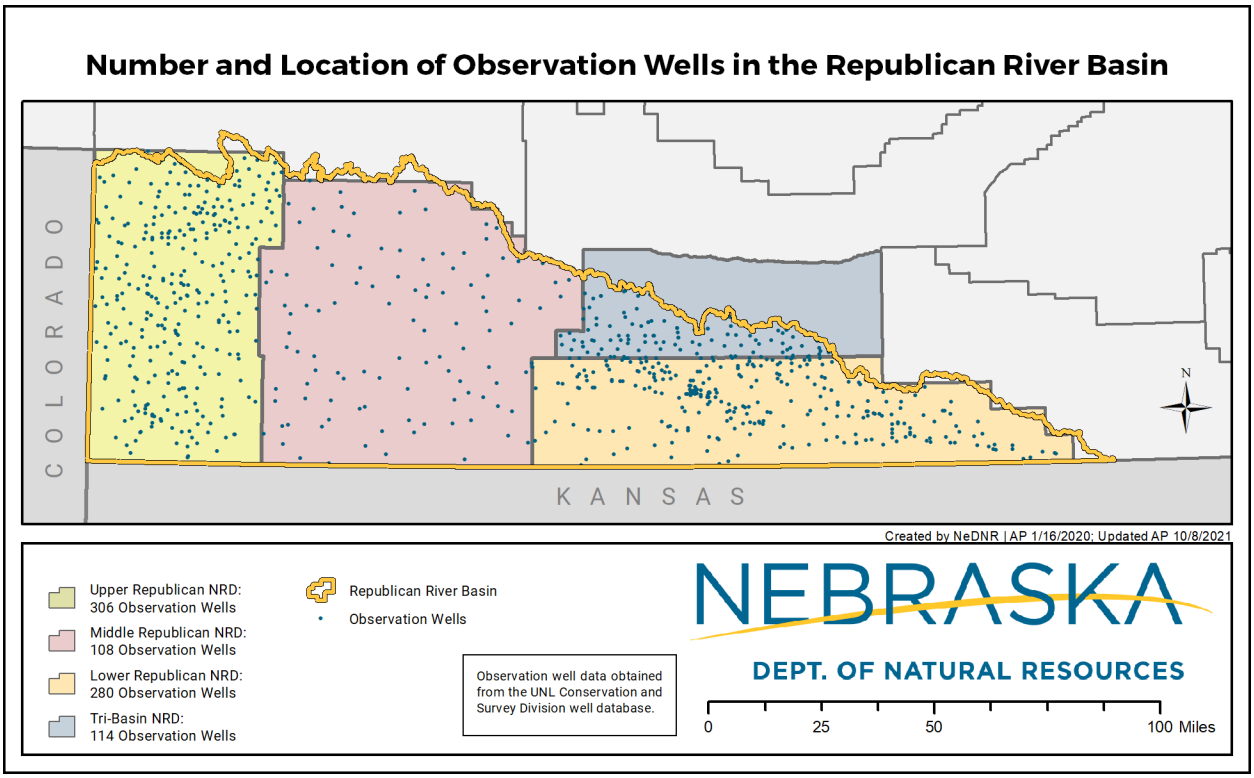

Figure 1. Location and number of groundwater observation wells within the Republican River Basin, by NRD, according to the University of Nebraska-Lincoln (UNL) Conservation and Survey Division well database.

Upper Republican Natural Resources District

Current Allocations

Upper Republican NRD's allocations and related rules for the 2018–2022 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, 2018–2022 allocation period.

Total Allocation	65 Inches/Acre/5 Years
Annual or Base Allocation	Allocation is over 5 Years, not annual
Maximum Annual Use	65 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 2022, 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, 2022. 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)
2022	430,290.5	430,290.5	585,226.5	16.3

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 2022. During 2022, 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. Contracts to decertify a total of 855 acres were signed in 2022. Many, but not all, of the acres in the new program are also enrolled in CREP; those that are will be permanently barred from being irrigated after CREP contracts expire.

Table 3. Acres within Upper Republican NRD that will no longer be irrigated due to enrollment in a permanent or temporary decertification program. During 2022, decertification programs in effect in this NRD included CREP and the NRD's own decertification program, partially funded by the State's Water Resources Cash Fund (WRCF). *CREP data are as of September 30, 2022.

Year	Acres Enrolled in CREP*	Acres Enrolled in WRCF programs	Acres Enrolled in Other Decertification Programs
2022	8,630.23	2,824	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 reported to the University of Nebraska-Lincoln Conservation Survey Division (CSD) by the NRDs and are made available to the public through CSD and U.S. Geological Survey (USGS) datasets. Groundwater level data from these publicly available datasets were generally utilized for the MHO C analysis. 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 will be submitted to the legislature in 2024 and made available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*. Additional 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 2022, 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 2018–2022 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, 2018–2022 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 2022, 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, 2022. 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)
2022	298,496.28	285,115.98	391,140.13	16.46

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 2022. During 2022, decertification programs in effect in this NRD included CREP. In 2022, Middle Republican NRD did not enter into any new contracts with landowners to permanently decertify additional acres from groundwater 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 2022, decertification programs in effect in this NRD included CREP and the NRD's own permanent decertification program, which is partially funded by the WRCF. *CREP data are as of September 30, 2022.

Year	Acres Enrolled in CREP *	Acres Enrolled in WRCF programs	Acres Enrolled in Other Decertification Programs
2022	14,554.92	0	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 reported to the University of Nebraska-Lincoln Conservation Survey Division (CSD) by the NRDs and are made available to the public through CSD and U.S. Geological Survey (USGS) datasets. Groundwater level data from these publicly available datasets were generally utilized for the MHO C analysis. 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 will be submitted to the legislature in 2024 and made available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*. Additional 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 2022, 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 2018–2022 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, 2018–2022 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 2022, 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, 2022. 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)
2022	319,179.84	310,468.26	255,215.70	9.87

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 2022. During 2022, 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 2022, decertification programs in effect in this NRD included CREP and other decertification programs. *CREP data are as of September 30, 2022.

Year	Acres Enrolled in CREP *	Acres Enrolled in WRCF programs	Acres Enrolled in Other Decertification Programs
2022	6,975.43	0	4,999.12

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 reported to the University of Nebraska-Lincoln Conservation Survey Division (CSD) by the NRDs and are made available to the public through CSD and U.S. Geological Survey (USGS) datasets. Groundwater level data from these publicly available datasets were generally utilized for the MHO C analysis. 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 will be submitted to the legislature in 2024 and made available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*. Additional 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 2022, 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 2021-2023 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, 2021-2023 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 2022, 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, 2022. 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)
2022	190,077.63	188,322.92	192,957	12.96

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 2022. During 2022, 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 2022, the decertification program in effect in this NRD included CREP. *CREP data are as of September 30, 2022.

Year	Acres Enrolled in CREP *	Acres Enrolled in WRCF programs	Acres Enrolled in Other Decertification Programs
2022	1,742.15	0	12.60

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 2022 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 2022. 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
2022	0	1,579.33

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 reported to the University of Nebraska-Lincoln Conservation Survey Division (CSD) by the NRDs and are made available to the public through CSD and U.S. Geological Survey (USGS) datasets. Groundwater level data from these publicly available datasets were generally utilized for the MHO C analysis, along with some revised, NRD-provided groundwater level data. 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 will be submitted to the legislature in 2024 and made available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*. Additional 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

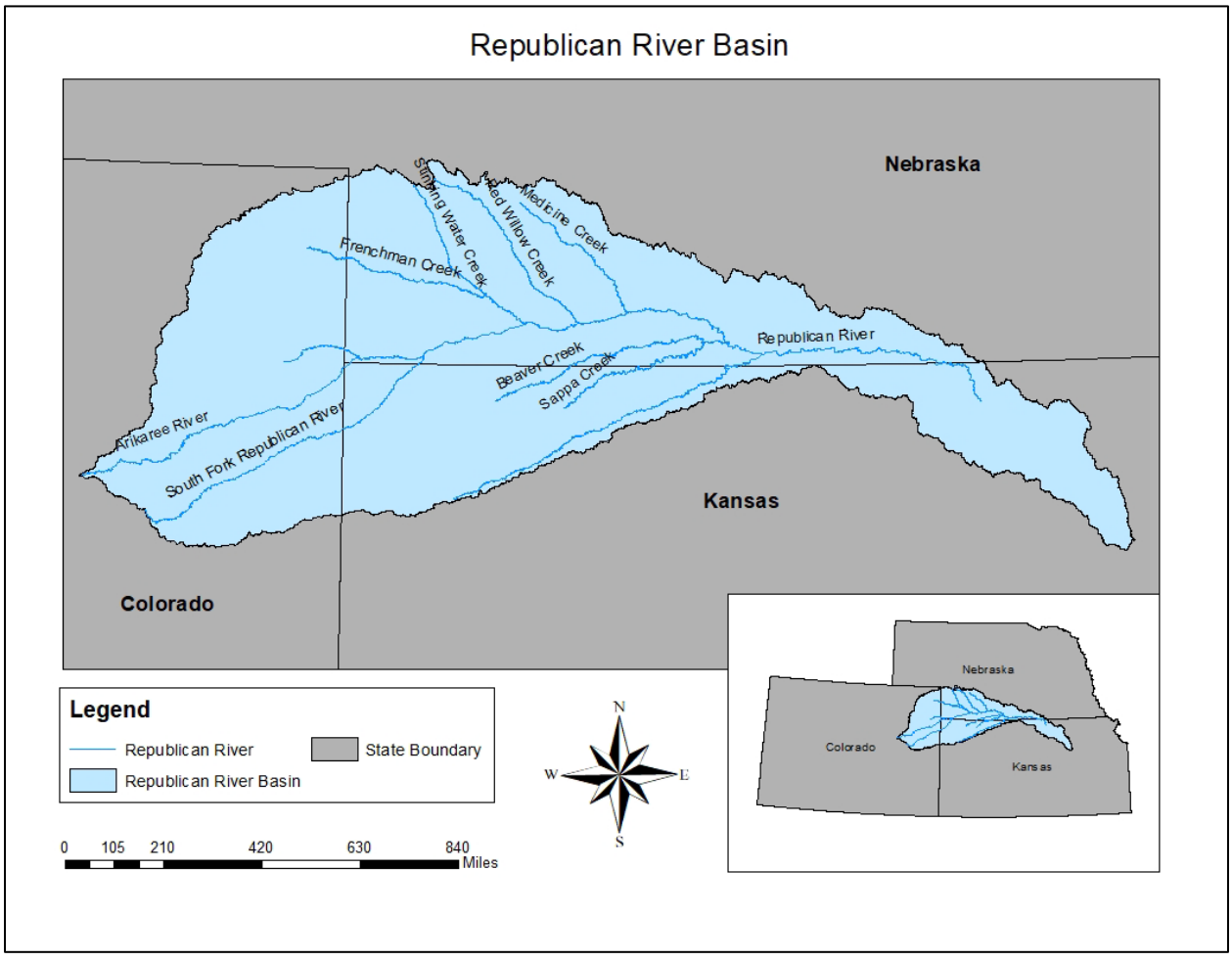

Figure 2. Extent of Republican River Basin within Nebraska, Kansas, and Colorado (USGS Hydrologic Unit Code: 102500).

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 2022, annual precipitation data used in RRCA analyses ranged from 8.7 inches to 24.43 inches. Figure 3 displays 2022 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.

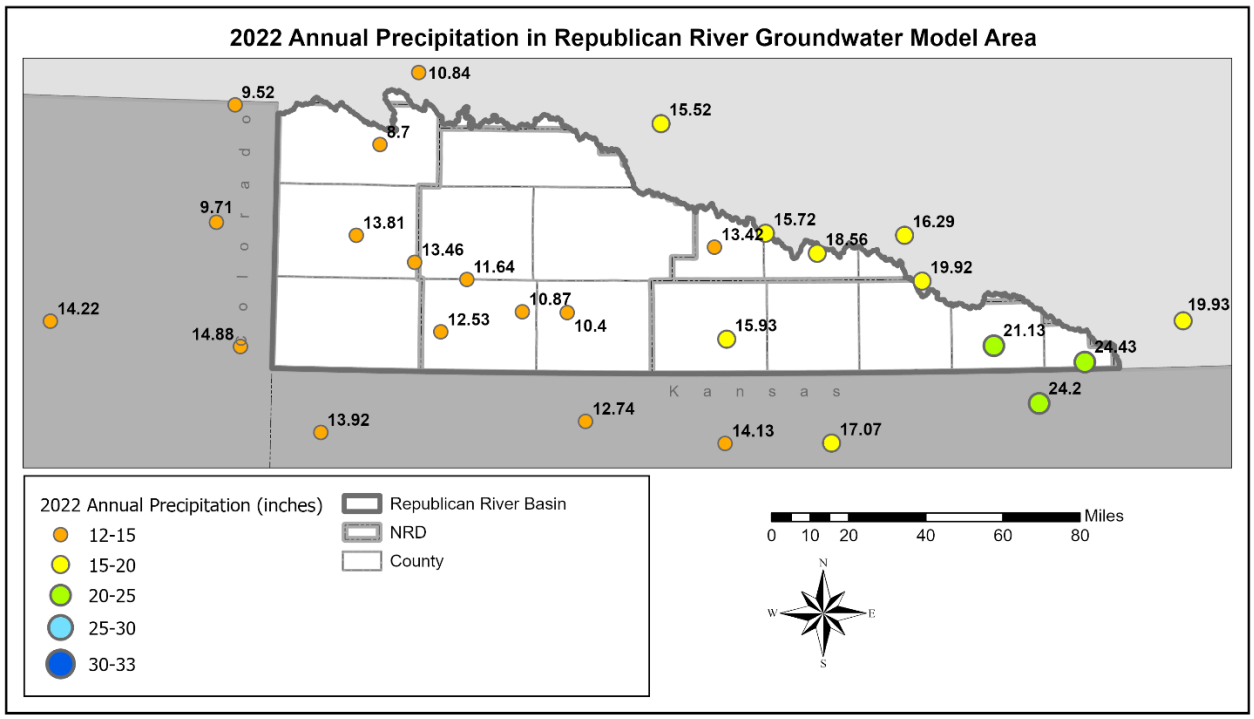

Figure 3. 2022 annual precipitation in inches from National Weather Service cooperative stations, as used in RRCA groundwater model processing.

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 2022. 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/*.

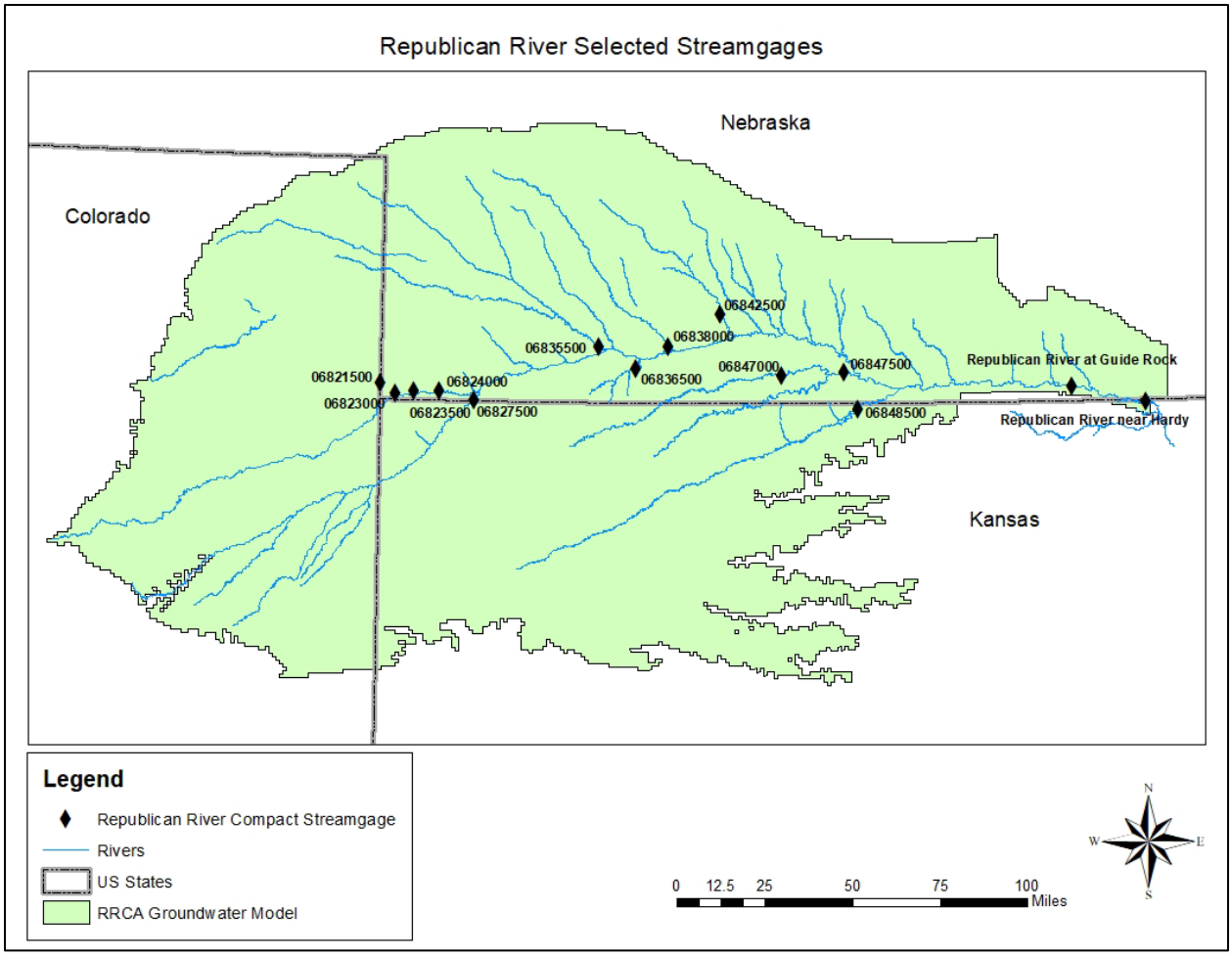

Figure 4. Location of subbasin streamgages within the Republican River Basin.

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	**2022**
USGS 06823000 - North Fork of the Republican River at Colorado-Nebraska State Line	21,129
USGS 06821500 - Arikaree River at Haigler	982
USGS 06823500 - Buffalo Creek near Haigler	1,030
USGS 06824000 - Rock Creek at Parks	2,955
USGS 06827500 - South Fork Republican River near Benkelman	0
USGS 06835500 - Frenchman Creek at Culbertson	10,761
USGS 06836500 - Driftwood Creek near McCook	992
USGS 06838000 - Red Willow Creek near Red Willow	2,678
NeDNR 06842500 - Medicine Creek below Harry Strunk Lake	29,716
USGS 06847000 - Beaver Creek near Beaver City	484
USGS 06847500 - Sappa Creek near Stamford	5,718
USGS 06848500 - Prairie Dog Creek near Woodruff, Kansas	2,414
USGS 06853020 - Republican River at Guide Rock	32,213
USGS 06853500 - Republican River near Hardy	69,608

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 2022 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.

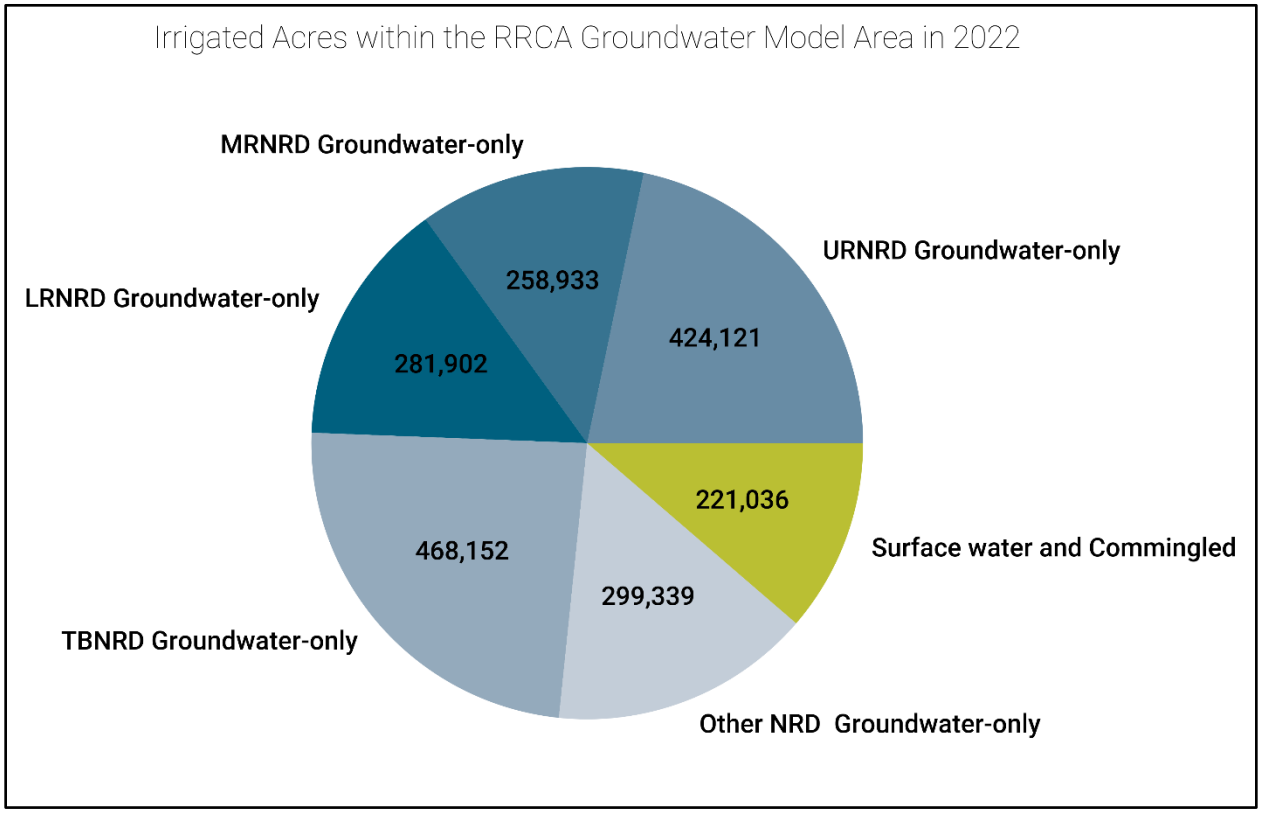

Figure 5. Irrigated Acres within the RRCA Groundwater Model Area in 2022.

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	2022
Nebraska Model Area – Surface Water and Commingled	221,036
Upper Republican NRD – Groundwater-only	424,121
Middle Republican NRD – Groundwater-only	258,933
Lower Republican NRD – Groundwater-only	281,902
Tri-Basin NRD – Groundwater-only	468,152
Other – Groundwater-only	299,339

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)	
	2022
Colorado	26,580
Kansas	67,770
Nebraska Surface Water	85,740
Lower Republican NRD Groundwater	41,975
Middle Republican NRD Groundwater	42,029
Upper Republican NRD Groundwater	67,838
Tri-Basin NRD Groundwater	10,045
Other NRD Groundwater	2,310

Reservoir Storage and Evaporation

Federal Reservoir Storage

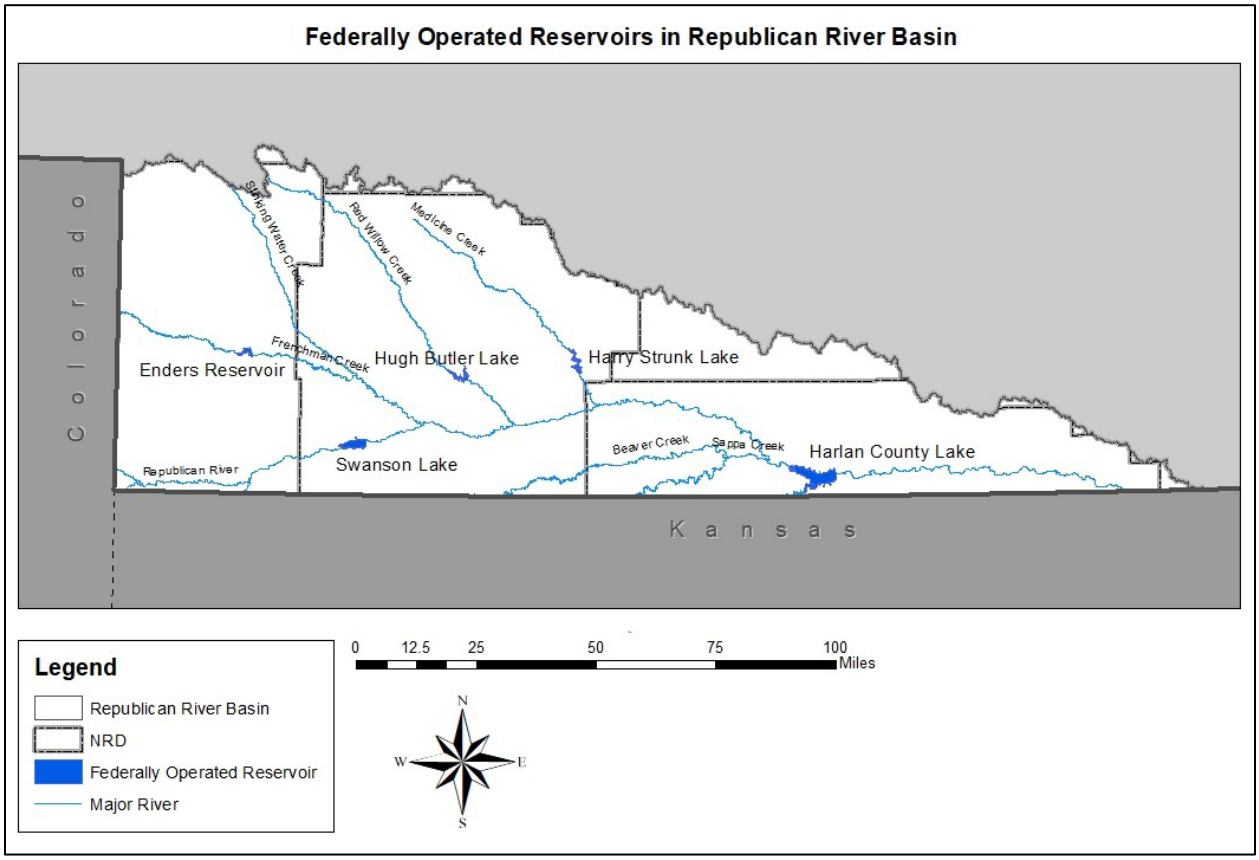

Figure 6. Location of federal reservoirs located in Nebraska portion of the Republican River Basin.

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 2022 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/*.

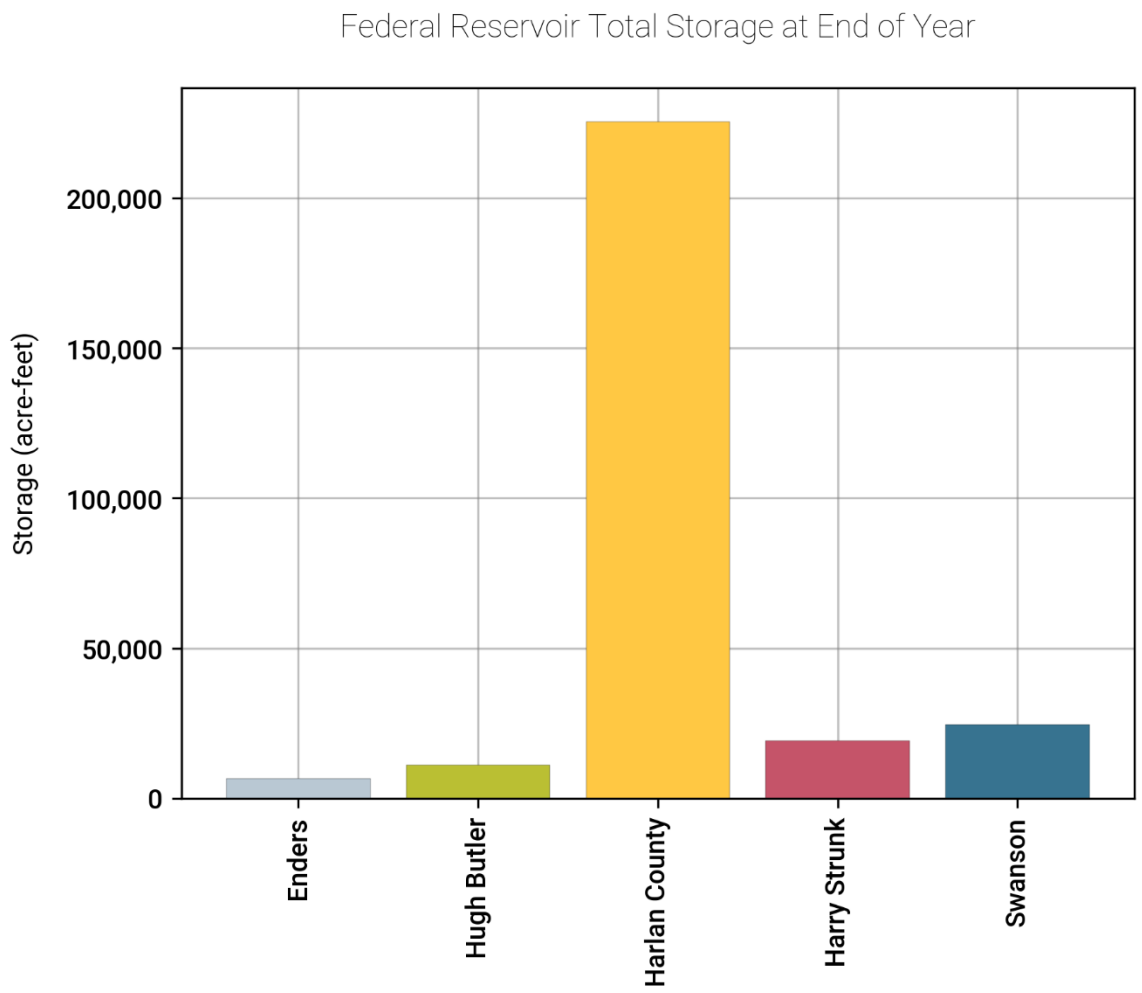

Figure 7. 2022 end-of-year reservoir contents for the federally operated reservoirs within the Republican River Basin in Nebraska: Enders Reservoir on Frenchman Creek, Hugh Butler Reservoir on Red Willow Creek, Harry Strunk Reservoir on Medicine Creek, and Swanson Lake and Harlan County Lake on the Republican River.

Reservoir Evaporation

Net evaporation from Republican River Basin reservoirs in Nebraska in 2022 was 52,295 acre-feet from the five federal reservoirs and 3,518 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. There was not a Compact Call in 2022.

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 entitled "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 2022. In addition, as stated in the progress summary for Action Item 1.1.2 (page 39) no management actions were necessary as offsets in 2022.

Some actions were taken in 2022 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.

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 15, 2023), which is available on NeDNR's website (*https://dnr.nebraska.gov*).

N-CORPE Augmentation Project

The Nebraska Cooperative Republican Platte Enhancement project (N-CORPE) 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 2022 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	Total Pumped Volume (acre-feet)
2022	0	2,878

Rock Creek Augmentation Project

The Rock Creek augmentation project is operated by Upper Republican NRD. A summary of Rock Creek augmentation project pumping for 2022 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	Pumped Volume (acre-feet)
2022	0	67

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 2022 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 2022. Figure 9 is a key describing the meanings of the symbols used throughout the "Management Activities" section.

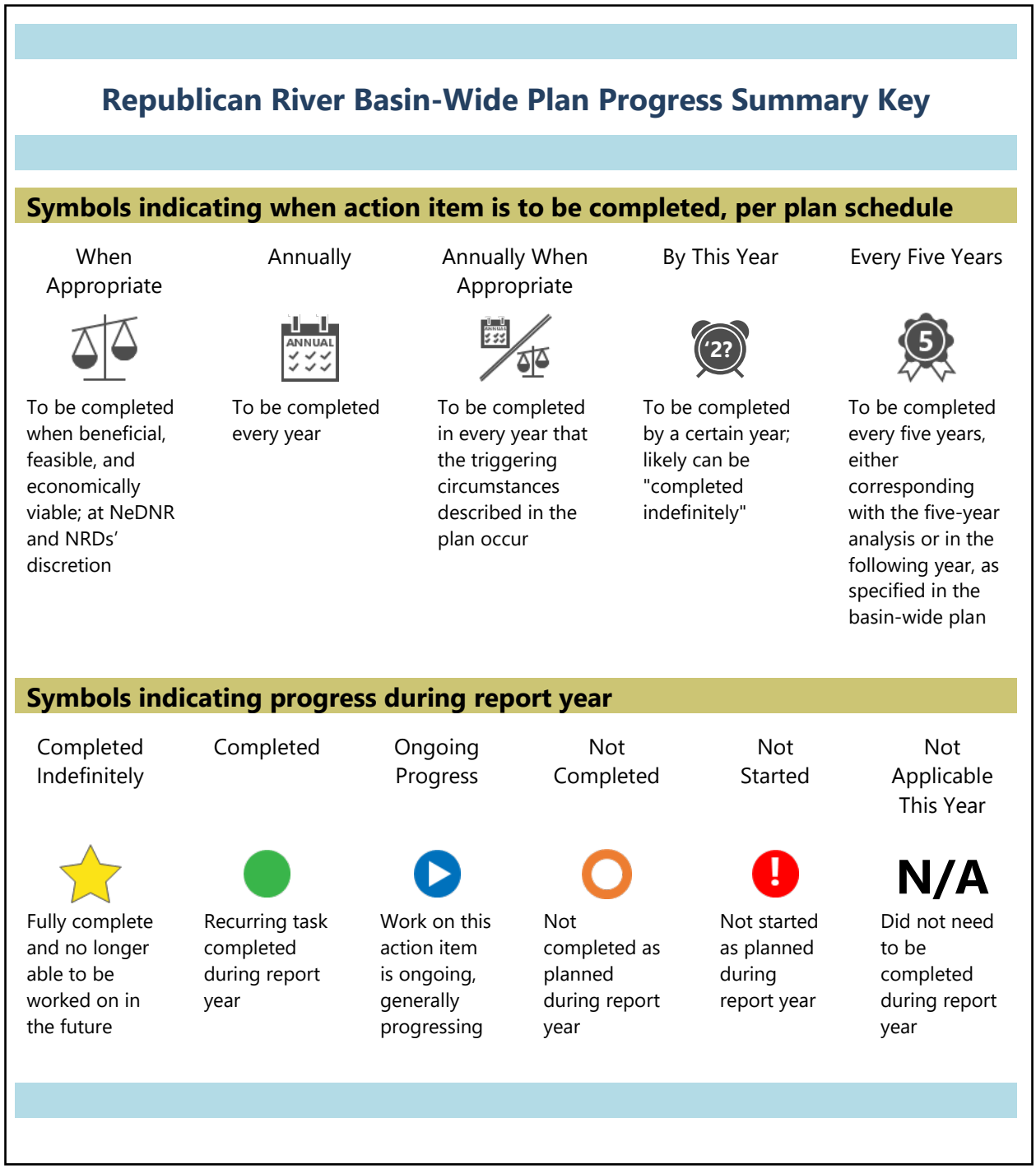

Figure 9. Key to symbols used throughout the "Management Activities" section. The report year for this report is 2022.

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 2022. 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 2022, and the "Progress" column contains more information about progress during 2022. 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		40

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.*		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*		Yes		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*		Yes		41
MHO D:	*Continue existing and initiate new actions that reduce the need for special regulations in the Rapid Response Area for Compact compliance*		Yes		41
MHO E:	*Continue existing and initiate new actions that reduce the need for administration of surface water use for Compact compliance*		Yes		42
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*		Yes		42
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*		No	**N/A**	43

Symbol Legend – See Figure 9 on page 31

Table 21. Visual summary of progress on Goal 2 during 2022. 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 2022, and the "Progress" column contains more information about progress during 2022. 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		44
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		45
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		48

Symbol Legend – See Figure 9 on page 31

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*		No	**N/A**	50
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		50
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		51
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		52
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**	52
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		52

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	●	53
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	★	54
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	**N/A**	54

Symbol Legend – See Figure 9 on page 31

Table 22. Visual summary of progress on Goal 3 during 2022. 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 2022, and the "Progress" column contains more information about progress during 2022. 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		55
3.1.2	*Educate civic leaders and the public on implementation efforts within the Basin*		Yes		55
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		56
3.1.4	*Propose and support changes to laws, policies, and rules that would incentivize reduced water consumption*		No	**N/A**	57
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		57
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		58
3.2.3	*Regularly communicate with the Plan's former Stakeholder Advisory Committee about implementation progress and potential Plan revisions*		Yes		58
3.2.4	*Encourage and support water users to share information about their management practice improvements with other water users and the public*		Yes		59

Symbol Legend – See Figure 9 on page 31

Table 23. Visual summary of progress on Goal 4 during 2022. 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 2022, and the "Progress" column contains more information about progress during 2022. 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		60
4.1.2	*Promote public recreation on the river, when doing so can also help to fulfill other goals of the Plan*		Yes		60
4.1.3	*Cooperate in projects to assess and restore riparian wetlands while also helping to fulfill other goals of the Plan*		Yes		60
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		61

Symbol Legend – See Figure 9 on page 31

Progress Summaries

This section contains descriptions summarizing 2022 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 2022. 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 2022, 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 2022 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 2022 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 2022.

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.

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 2022. A qualitative evaluation of the net effect on water supplies of any management actions that were taken for Compact compliance during 2021 was presented at the fourth annual meeting to review progress on the basin-wide plan, which took place in November 2022. The qualitative evaluation can be found on page 27 of the *Fourth Annual Report for the Republican River Basin-Wide Plan: Data and Progress Updates, 2021 (November 15, 2022)* 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 2022 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.

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. A report on the results of this analysis will be submitted to the legislature in 2024.

Symbol Legend – See Figure 9 on page 31

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 2021, and the results were presented at the fourth annual meeting to review progress on the basin-wide plan, which took place in November 2022. The analysis and results are described beginning on page 64 of the *Fourth Annual Report for the Republican River Basin-Wide Plan: Data and Progress Updates, 2021 (November 15, 2022)*, which can be downloaded from the basin-wide plan website, https://rrbwp.nebraska.gov.

The current year's (2022) evaluation of MHO A can be found under "MHO A Evaluation" on page 62 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*

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. A brief summary of analysis results can be found under "MHO B Evaluation" on page 66 of this report. 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 will be submitted to the legislature in 2024 and made available for download on the basin-wide plan website, https://rrbwp.nebraska.gov .

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 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. A brief summary of analysis results can be found under "MHO C Evaluation" on page 67 of this report. 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 will be submitted to the legislature in 2024 and made available for download on the basin-wide plan website, https://rrbwp.nebraska.gov

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

Symbol Legend – See Figure 9 on page 31

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 in 2022 to review progress on the basin-wide plan. Results were presented at the fourth annual meeting, which took place in November 2022. The analysis and results can be found on page 68 of the *Fourth Annual Report for the Republican River Basin-Wide Plan: Data and Progress Updates, 2021 (November 15, 2022)*. 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 68 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.

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 trigged under terms of the Final Settlement Stipulation (FSS) is not evaluated as part of MHO E.

MHO E was evaluated in 2022 to review progress on the basin-wide plan. Results were presented at the fourth annual meeting, which took place in November 2022. The analysis and results can be found on page 69 of the *Fourth Annual Report for the Republican River Basin-Wide Plan: Data and Progress Updates, 2021 (November 15, 2022),* 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 68 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

Symbol Legend – See Figure 9 on page 31

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*

N/A

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 is in-progress as of the issuance date of this report, and will be submitted to the legislature in 2024. This report will be made available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*.

Symbol Legend – See Figure 9 on page 31

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*

Lower Republican NRD utilizes a model for project evaluation and management decisions; the model is being used to evaluate proposed locations for potential water storage and streamflow augmentation. These efforts initiated the National Environmental Policy Act (NEPA), which requires analyzing all the components addressed in section 2.1.1. 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) to hire a consultant to further evaluate the proposed sites for water storage, streamflow augmentation, and other beneficial uses. The WFPO grants that the NRD received for two of the proposed sites will be completed by March 2024. A third site was part of a preliminary investigative feasibility review (PIFR) that began in July of 2021; WFPO funding awards will be announced in 2023.

Middle Republican NRD continues to utilize the WaterSMART Program and the WRCF to install telemetry irrigation flow meters in the NRD. Approximately 2,000 telemetry meters have been installed, which is about 75% of the total meters. These meters will provide not only accurate and timely water information to producers and the MRNRD, they will provide a base for addressing water quality concerns and improved water management efforts. In 2022, NeDNR signed a contract using WRCF for nine hundred thousand dollars to support MRNRD's efforts to install the telemetry meters.

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. The application is being evaluated for approval by NeDNR. All ongoing and future

Symbol Legend – See Figure 9 on page 31

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**

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 2022.

The URNRD continued to promote irrigators' use of evapotranspiration estimates from URNRD weather stations to inform irrigaton decisions that prevent instances of unnecessary water usage. Data from a University of Nebraska ET eddy covariance instrument partially paid for and maintained by the URNRD was also provided to irrigators.

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 10).

The URNRD discussed with irrigators a proposed reduction in the five-year allocation to reduce District-wide water use.

Symbol Legend – See Figure 9 on page 31

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

Figure 10. Two different mounting systems for Upper Republican NRD telemetry project.

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. NeDNR continued discussions with FVID in 2022 about potential improvements to FVID's infrastructure.

Lower Republican NRD has an agreement with NBID that establishes water savings through the placement of automated gates.

In 2022, NeDNR signed a contract with NBID to provide matching funds for a large scale WaterSMART Grant from the Bureau of Reclamation, 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 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

Figure 11. New Rubicon gates on canal operated by Frenchman-Cambridge Irrigation District.

Symbol Legend – See Figure 9 on page 31

from being released from Harlan County Reservoir. 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 11). FCID continued work on this project in 2022.

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*

All four Republican River Basin NRDs participate in the Conservation Reserve Enhancement Program (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 incentivized re-enrollment of 130 CREP acres with high impacts on stream flow that will be permanently prohibited from being irrigated at the expiration of the CREP contract. Upper Republican NRD and NeDNR (via the Water Sustainability Fund) provided cost share for 100 soil moisture probes on approximately 13,000 acres that reduced water use by an estimated 1,000 to 2,000 acre-feet in 2022. The project will make water usage data more readily available to irrigators, with an intended outcome of reducing water use.

Middle Republican NRD has a program to decertify irrigation rights or appropriations on cropland. This program is funded by Middle Republican NRD and the WRCF, which is administered by NeDNR. No new contracts were entered into with landowners in 2022.

Middle Republican NRD continues to support the Nebraska Cooperative Republican Platte Enhancement (N-CORPE) augmentation project.

Lower Republican NRD 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 12). 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.

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Figure 12. Prescribed burn on Platte-Republican Diversion land, April 20, 2020, courtesy of Tri-Basin NRD.

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. Additionally, the NRD provided a letter of support for the NBID Superior Canal WaterSMART grant. The grant application was successful, and planning for project design began in 2022.

Some 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, third, and fourth basin-wide plan annual meetings were held in November 2020, November 2021, and November 2022, 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.

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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 2022, 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 2022, 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 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.

In an effort to improve the district's rules and regulations, the Upper Republican NRD communicated with other NRDs in the Republican River Basin about the district's rules, specifically regarding variance requests.

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.

Currently, Lower Republican NRD has supported work with NeDNR on the 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.

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 1,445 certified irrigated acres enrolled in the program.

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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.

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*

N/A

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.

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.

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 will be submitted to the legislature in 2024 and made 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.

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 13). Data collection and analysis are ongoing, and the project is progressing as planned.

Figure 13. 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

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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. 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 the UNL Public Policy Center, will be 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 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,*

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2019-2022 report which will be submitted to the legislature in 2024 and made available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*. Results were presented at the fifth annual meeting to review progress on the basin-wide plan, which took place in November 2023.

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*.

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 does support the irrigation districts, their sponsors, and their sponsor's 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. Lower Republican NRD would support the irrigation districts, their sponsors, and their sponsor's 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 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.

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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.

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 will be made 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*

N/A

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

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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 2022 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 2022. 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 2022 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 described augmentation and other water management programs to members of the Legislature's Natural Resources Committee and University of Nebraska officials. Locally, the NRD shared information about Compact compliance forecasts by posting information on the district's website, the NRD newsletter, and through presentations to community leaders in the District. Upper Republican NRD also helped publicize efforts by Southwest Weed Management District to control invasive species in stream corridors throughout the Basin.

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 public on the happenings of the water world within South Central Nebraska. NeDNR

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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 in the fall of 2022. 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, entitled 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.

In 2022, NeDNR published a StoryMap about the WRCF. A StoryMap is a platform for combining text and maps to illustrate where stories take place. The purpose of the WRCF StoryMap is to showcase the ways in which NeDNR has used the WRCF to support NRD and Irrigation District projects that contribute towards conserving, enhancing, and restoring Nebraska's groundwater and surface water resources. The WRCF StoryMap is available on the NeDNR website at: *WRCF StoryMap*

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 2022. 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 2022 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. They 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 2022. NeDNR produces a monthly podcast that is available on multiple platforms, and drought was the focus of the December 2022 episode.

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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 Final Settlement Stipulation, and other important Compact-related documents.

NeDNR and the NRDs also addressed these topics in 2022 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 2022 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.

Upper Republican NRD worked with local NRCS officials to prioritize the District's resource concerns in their programs such as Environmental Quality Incentives Program (EQIP). Decertification of water use and/or tools to improve irrigation scheduling were emphasized.

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. Some RRCA data are also available on NeDNR's INSIGHT (Integrated Network of Scientific Information & GeoHydrologic Tools) website (*http://nednr.nebraska.gov/INSIGHT/*).

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.

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

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 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.

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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 2022, 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 of 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 2022 is provided in Table 24.

Table 24. Summary of Republican River Basin TAPS teams and Winning TAPS teams from 2017 through 2022.

NRD or other	Number of Teams	Number of Winning Teams
TBNRD	13	5
URNRD	8	3
MRNRD	34	9
LRNRD	22	3
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 2022. Upper Republican NRD has opened approximately 2,500 acres it owns near the Rock Creek Augmentation project in Dundy County to public hunting and manages the property to successfully re-establish native grass on formerly irrigated cropland. Upper Republican also partnered with Ducks Unlimited to acquire a 55-acre wetland in Chase County that is open to the public and managed cooperatively with the Natural Resources Conservation Service. Middle Republican NRD conducts efforts through the N-CORPE Augmentation Project including public outreach, public hunting, and funding opportunities for improvements. "Planting for Pheasants Forever" plantings are provided by the 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. 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*

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 the River and open lands within the Basin.

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. Lower Republican NRD and Tri-Basin NRD financially support 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.

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Upper Republican NRD has a representative on the board of the Southwest Weed Management District and monitors its progress toward meeting riparian restoration goals.

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 has been actively involved in the weed district's activities. 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 62.

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 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 63.

MHO A Evaluation Results for 2022

MHO A evaluation results are summarized in Table 26. For 2022, 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 2022.

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 2022			

According to the Compact accounting procedures, the averaging period applicable to 2022 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 sum 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 2022 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 2022.

Table 27. MHO A evaluation results for 2022, 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 (2022) and the previous four years, in conformance with RRCA Accounting Procedures.

	Difference between allowable depletions an actual groundwater net depletions (acre-feet)		
Year	**Lower Republican NRD**	**Middle Republican NRD**	**Upper Republican NRD**
2018	540	-1,919	2,922
2019	40,262	46,951	65,758
2020	14,844	28,487	26,335
2021	2,229	12,180	12,577
2022	-6,497	2,063	-7,059
5-year average (2018–2022)	**10,185**	**17,552**	**20,106**
5-year average positive?	**Yes**	**Yes**	**Yes**

Tri-Basin NRD Hydrologically Balanced Assessment Results for 2022

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 2022 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 2022.

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 2022 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 2022 to offset net depletions from previous year's assessment. Discussion of next steps is required.
Tri-Basin NRD's Results for 2022	

Full details of the hydrologically balanced assessment for 2022 are included in NeDNR's report for the IMP for the Republican Basin portion of Tri-Basin NRD, entitled *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 2022 (Figure 14), 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 2022 test. In addition, no management actions were required to be taken by Tri-Basin NRD in 2022 to offset the results of a previous year's test.

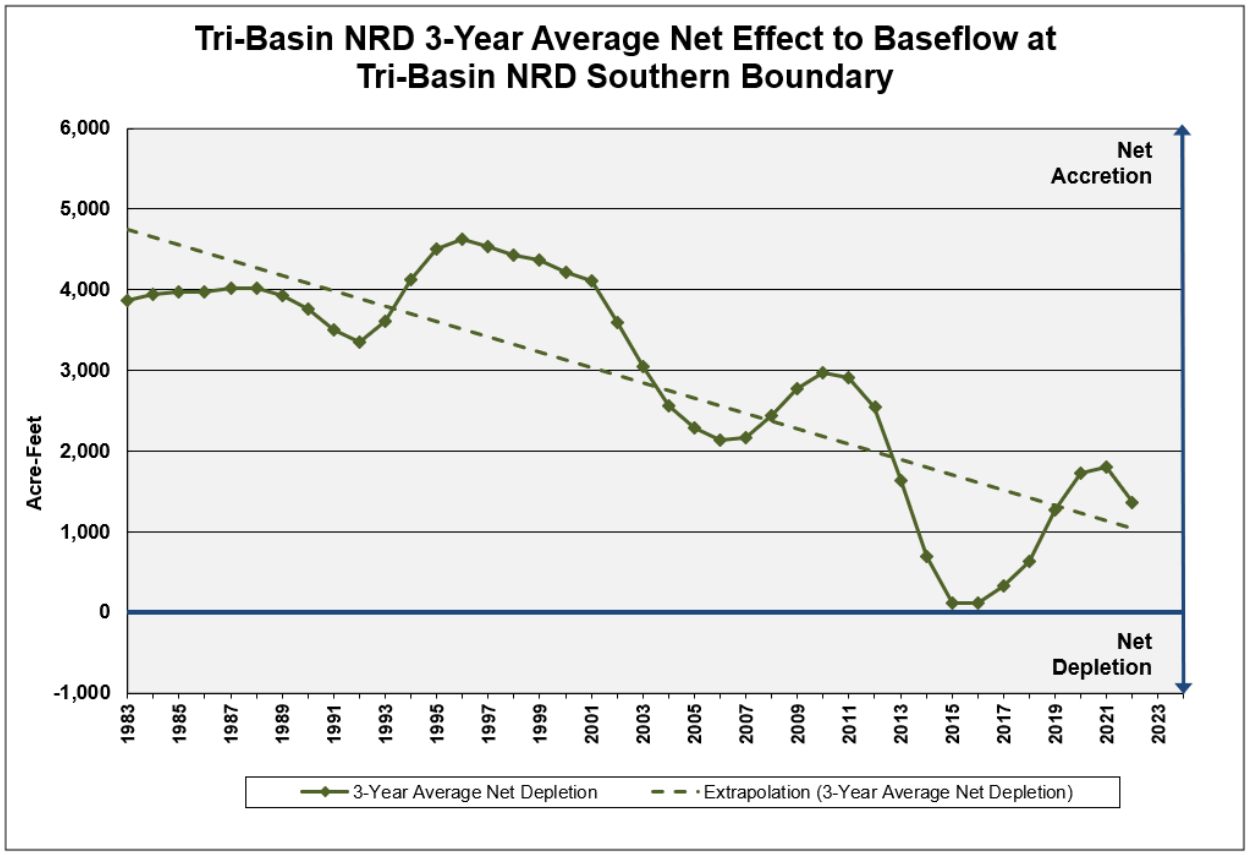

Figure 14. Rolling three-year average net effect to baseflow as the total of modeled values of streamflow depletion and mound accretions, using the August 2020 RRCA Accounting Procedures and the RRCA groundwater model.

MHO B Evaluation

MHO B Assessment Criteria

MHO B is to 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. For full details on the methodology used to evaluate MHO B, see the *Supplement to the Republican River Basin-Wide Plan: Methodology for MHO B* which is available for download on the Republican River Basin Wide Plan page on the NeDNR website, *https://dnr.nebraska.gov/*.

MHO B Evaluation Results

MHO B was evaluated in 2023 as a subset of the first five-year technical analysis. This evaluation included data from 2008 – 2022 for Upper Republican, Middle Republican, and Lower Republican NRDs, and from 2013 – 2022 for Tri-Basin NRD. A summary of MHO B evaluation results is presented in Table 29. For the first five-year technical analysis, MHO B is being achieved for Upper Republican, Middle Republican, Lower Republican, and Tri-Basin NRDs. For full details of analysis results, see the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report, which will be made available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*

Table 29. Summary of MHO B results for the first five-year technical analysis.

Key to Possible Test Results	MHO is being achieved. No trend or a statistically significant decrease in depletions was observed for unmodified and all three categories of decorrelated depletions. Caution. A statistically significant increase in unmodified or at least one of the three categories of decorrelated depletions was observed. Further investigation is needed.			
NRD	**Upper Republican**	**Middle Republican**	**Lower Republican**	**Tri-Basin**
NRD's Results for First Five-Year Technical Analysis				

MHO C Evaluation

MHO C is evaluated every five years as part of the basin-wide plan's five-year technical review.

MHO C Assessment Criteria

MHO C is to ensure there is always enough groundwater for all groundwater uses within the timeframe of the basin-wide plan. For full details on the methodology used to evaluate MHO C, see the *Supplement to the Republican River Basin-Wide Plan: Methodology for MHO C* which is available for download on the Republican River Basin Wide Plan page on the NeDNR website, *https://dnr.nebraska.gov/*.

MHO C Evaluation Results

MHO C was evaluated in 2023 as a subset of the first five-year technical analysis. Basin groundwater levels were assessed using a statistical trend analysis (Mann-Kendall Trend Test) of average spring groundwater levels (between February 24 and May 15) for wells in publicly available United States Geological Survey (USGS) and University of Nebraska-Lincoln Conservation and Survey Division (CSD) datasets. The majority of wells for which average groundwater levels were analyzed (72%) showed either no trend or an increasing trend and 248 (28%) showed a decreasing trend. Further investigation will be conducted by NeDNR and the Basin NRDs and management actions will be implemented if determined necessary as described in the *Methodology for MHO C Supplement to the Plan*. For full details of analysis results, see the *First Five-Year Technical Analysis for the Republican River Basin-Wide Plan: Results and Plan Progress Updates, 2019-2022* report, which will be made available for download on the basin-wide plan website, *https://rrbwp.nebraska.gov*

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 2022

MHO D evaluation results are summarized in Table 30. For 2022, 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 2022 to ensure Compact Compliance.

Table 30. Summary of MHO D results for 2022.

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 2022			

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 Final Settlement Stipulation (FSS) is excluded from MHO E. For more information, see "Surface Water Administration for Compact Compliance," page 26.

MHO E Evaluation Results for 2022

MHO E evaluation results are summarized in Table 31. For 2022, 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," page 26.

Table 31. Summary of MHO E results for 2022.

Key to Possible Test Results	MHO is being achieved. NeDNR did not administer surface water to ensure Compact compliance, except as required under the Final Settlement Stipulation (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 2022	

Figure 15. Thunderstorm west of Holdrege, photo courtesy of Tri-Basin NRD.

Attachment D

Report on the Republican River Basin Drought Planning Exercise

Nebraska Department of Natural Resources
Lower Republican Natural Resources District
Middle Republican Natural Resources District
Tri-Basin Natural Resources District
Upper Republican Natural Resources District
November 15, 2023

Summary

This report provides an account of the 2022 drought planning exercise project in the Republican River Basin of Nebraska (Basin). The report includes a brief history of drought in the region, details about project development, exercise objectives, key takeaways, and recommended actions to help the Republican River Basin Natural Resources Districts (NRDs) and the Nebraska Department of Natural Resources (NeDNR) better prepare for and manage drought.

Table of Contents

1.0 Introduction

1.1 Background

The Republican River and its tributaries are vitally important to parts of the Central Great Plains of North America. Covering roughly 16 million acres across portions of eastern Colorado, southwest Nebraska and northwest Kansas, the Republican River Basin[1] includes highly productive agricultural lands, large reservoirs with recreational and wildlife habitat features, and established communities that rely on the agriculturally driven economy and the water supplies that sustain it.

Following an extensive drought in the 1930s and a devastating flood in 1935, the three Basin states negotiated the Republican River Compact, which became effective in 1943. The compact continues to provide an apportionment of the Republican River's water supply between the three states. Years in which NeDNR's analysis indicates Nebraska may not be in compliance with the Republican River Compact unless additional management actions are taken are designated as Compact Call Years (CCY) (handout is under the "Links and Related Materials" section). In a CCY, Nebraska must take additional action to meet its Compact obligations by reducing consumption or generating additional streamflow.

In Nebraska, surface water and groundwater resources are managed differently. Surface water rights are managed by NeDNR and are administered based on a prior appropriation doctrine. This means that surface water rights are prioritized based on the date they are issued and therefore, in times of shortage, junior rights can be shut off until senior rights are fulfilled. Groundwater, however, is managed as a correlative resource by local NRDs. This means that groundwater is shared among users as a common resource regardless of when a permit is issued. Because groundwater and surface water are hydrologically connected in areas throughout the Basin, the Upper Republican, Middle Republican, Lower Republican, and Tri-Basin NRDs and NeDNR work together to jointly manage the Basin's water resources and ensure compact compliance.

In 2004, the Nebraska Legislature passed LB 962, which requires the development of an Integrated Management Plan (IMP) for any NRD located within a fully appropriated river basin. IMPs outline the usage and management of hydrologically connected surface

[1] United States Geological Survey Hydrologic Unit Code: 102500

water and groundwater resources at the NRD level. *Nebraska Revised Statute* § 46-715 provides the statutory requirements for IMP development.

Furthermore, *Neb. Rev. Stat.* § 46-755 requires that a Basin-Wide Plan (BWP) be established when a river basin includes three or more NRDs with IMPs required under *Neb. Rev. Stat*. § 46-715. Therefore, in 2019, a BWP for the Republican River Basin was created and implemented. This plan helps to ensure compact compliance and provide consistency between the Basin's IMPs.

***Neb. Rev. Stat.* § 46-715, subsections (1)(a) and (2)(a)**

(1)(a) Whenever the Department of Natural Resources has designated a river basin, subbasin, or reach as over appropriated or has made a final determination that a river basin, subbasin, or reach is **fully appropriated**, the natural resources districts encompassing such river basin, subbasin, or reach and the department shall jointly develop an integrated management plan for such river basin, subbasin, or reach.

(2)(a) An integrated management plan shall include: Clear goals and objectives with a purpose of sustaining a balance between water uses and water supplies so that the economic viability, social and environmental health, safety, and welfare of the river basin, subbasin, or reach can be achieved and maintained for both the near term and the long term.

Action item 2.8.1 of the BWP tasks the four Republican Basin NRDs and NeDNR to develop and participate in a drought planning exercise within the first four years of the plan's implementation. To plan the exercise, the NRDs and NeDNR partnered with the National Drought Mitigation Center (NDMC). The exercise was held in May of 2022.

Some areas of focus for the exercise, as stipulated in the BWP, are:

- Increasing understanding of the needs for and logistics of storing water for use during a drought.
- Evaluating the existing and potential new management actions to determine the long-term availability trends that provide carry-over storage to meet crop-water needs during drought.

- Developing metrics that could be used to evaluate whether conservation of water for future use during a drought is successful.

1.2 Drought History and Economic Impact

The Basin has historically cycled between years of above and below average precipitation. Consecutive dry years and acutely dry years have resulted in numerous droughts within the period of recorded climate data (beginning 1895), including significant droughts in the 1930s, 1950s, mid 2000's, and 2012-2014. Figure 1 shows the percent of the Basin in Drought per the U.S. Drought Monitor (USDM) from 2000 – 2022. Figure 2 depicts the percent of the Basin experiencing drought conditions in each year from 1895 – 2021 rated from abnormally dry (D0) to exceptional drought (D4) and conversely wet conditions ranging from abnormal (W0) to exceptional (W4) on the Standardized Precipitation Index (SPI), which is a measure of meteorological drought.

The NOAA National Center for Environmental Information (NCEI) estimated the total economic losses from drought in the United States at $290.7 billion from 1980 – 2020 (NCEI, 2022). Nebraska was estimated to have lost $1.2 billion in 2002 due to drought (Hayes et al., 2004; cited in Knutson et al., 2011). The NCEI estimated an average of $7.1 billion in economic losses per year due to drought in the U.S. since 1980, and others estimated the figure at $10 - $14 billion (Kuwayama et al., 2018).

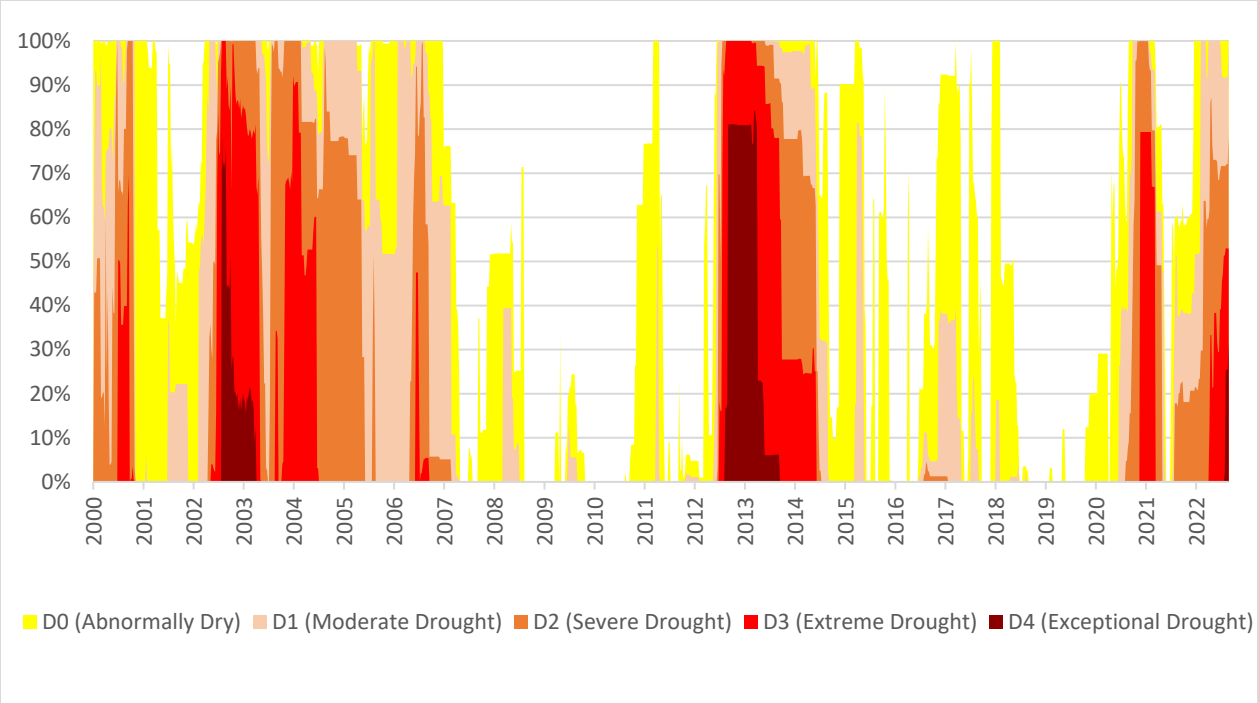

Figure 1: Percent of Republican Basin in Drought per U.S. Drought Monitor (USDM) 2000 - 2022

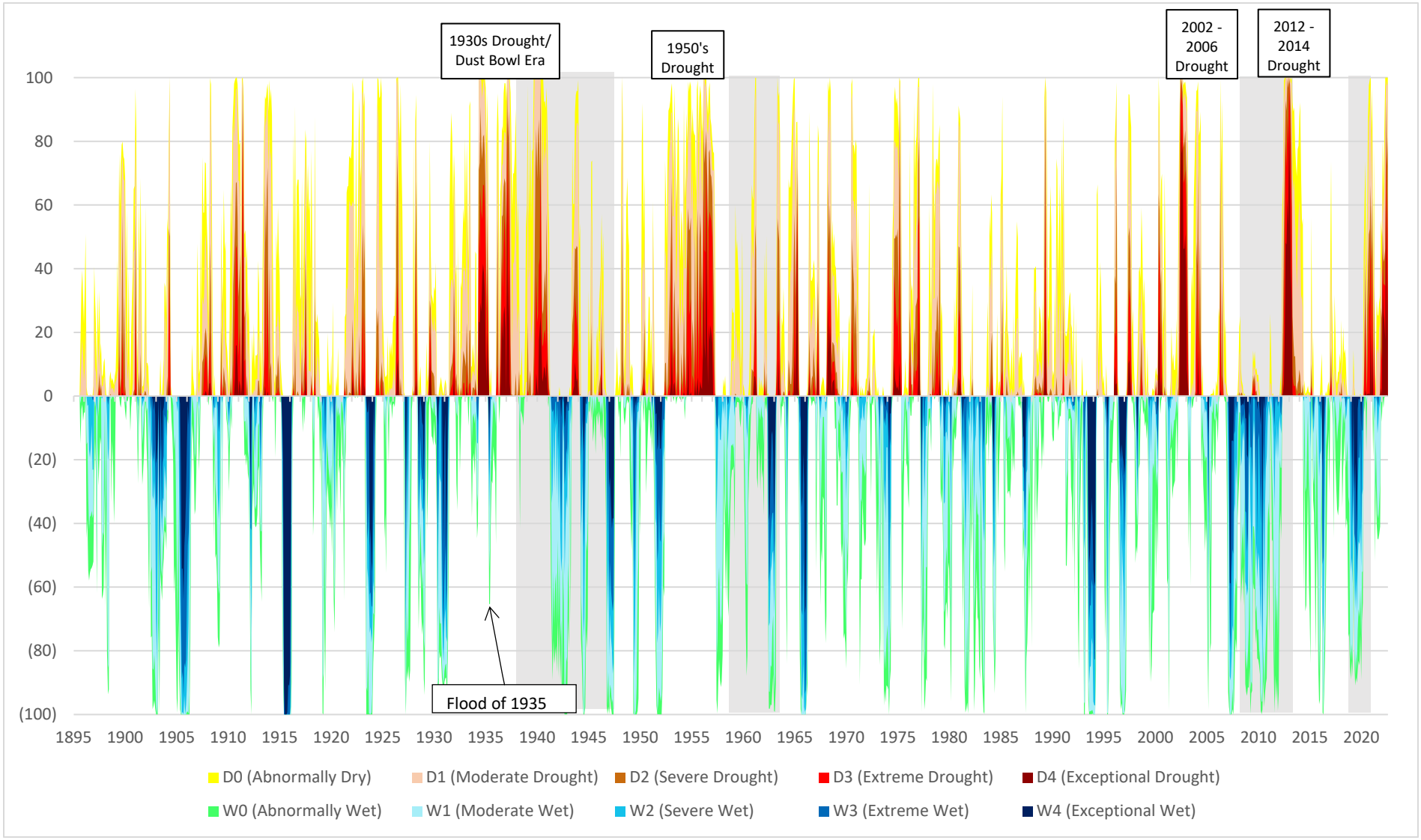

Figure 2: Standardized Precipitation Index (SPI) Percent Cover in Republican Basin: 1895 - 2021

1.3 Existing Controls Used During Drought or Dry Periods

Information about actions taken by the Republican NRDs during Compact Call Years is outlined in the NRDs' IMPs and the BWP (under the "Planning" tab), and CCY handout (under the "Links and Related Materials" section) on the NeDNR website.

Examples of groundwater controls include groundwater allocations, a moratorium on new wells and irrigated acres, and requiring metering of all groundwater uses. Examples of surface water controls include recognizing the priority date of February 26, 1948, for Kansas Bostwick Irrigation District and Nebraska Bostwick Irrigation District, closing junior water rights as required by controlling RRCA documents, and protecting storage releases from Harlan County Lake for delivery at Guide Rock from surface water diversions.

2.0 Drought Planning Exercise

The project ran from August 2020 to January 2023. A committee of experts from the NeDNR, the NDMC and a Graduate Research Assistant from the University of Nebraska-Lincoln was assembled to develop the exercise with the cooperation and consultation of the four Republican Basin NRDs.

The project was staged into three phases (Figure 3). Phase 1 was dedicated to researching and establishing a framework for the drought exercise. Phases 2 and 3 were dedicated to the development of scenario exercises, conducting the drought exercise event and reporting.

2.1 Phase 1: Research and Identification of Exercise Framework

In Phase 1, a considerable amount of research and literature review was conducted to understand how water resources are managed in the Basin and determine which type of scenario-based exercise best meets the requirements of the BWP.

2.1.1 Scenario Based Exercises Background

Scenario based exercises provide innovative ways to engage community leaders, regulators, and other stakeholders in collaborative discussions about planning and policy-oriented issues. Commonly used to prepare for complex problems like drought, they bring together participants with different perspectives to work through difficult scenarios and discuss how to approach complex challenges. These types of exercises are particularly useful because they:

- Stimulate creative thinking for mitigation, response, and adaptation strategies.
- Help participants learn about different views and perspectives on drought.

- Identify gaps in existing regulation and potential vulnerabilities.
- Foster better communication and relationships among participants/stakeholders.
- Clarify agency/organizational roles and responsibilities.
- Test and improve coordination among organizations involved in drought response.
- Practice making drought management decisions using the available operational tools.

The coordination committee evaluated materials published by the NDMC that detailed four distinct exercise types then outlined resource requirements for each type based on desired outcomes. Table 1 provides a brief description of the benefits, drawbacks, and most effective applications of the four exercise types (Bathke, 2019):

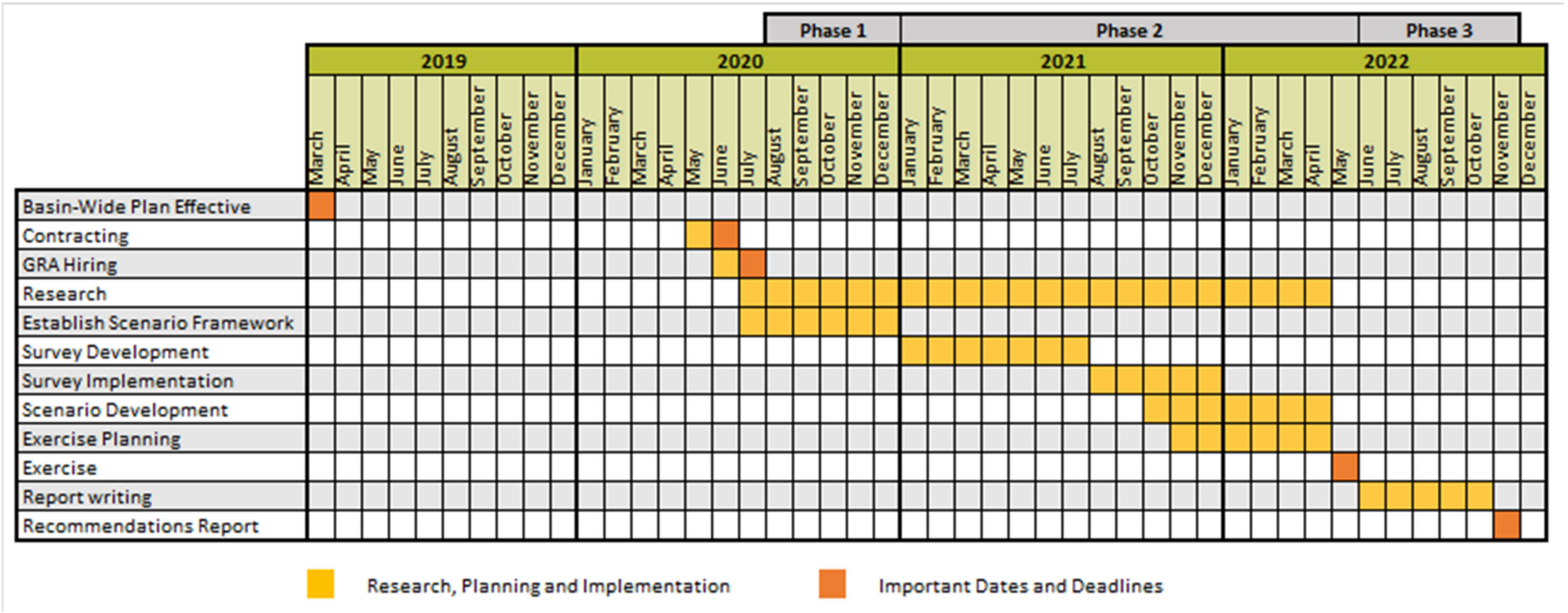

Figure 3: Drought Planning Exercise Timeline

Table 1. Scenario Exercise Types

Exercise Type	Description
Workshop	Requires fewer resources, encourages collaboration and coordination among stakeholders, and encourages participation of the general public.
Tabletop	Requires fewer resources, good for education and training, encourages consensus building, collaboration, and coordination among stakeholders, good for plan evaluation and modification.
Game	Moderately expensive to use, encourages collaboration and coordination among stakeholders, and encourages participation of the general public.
Functional	Most expensive to use, good for already existing plans, has limited interaction with experts, more realistic and tense, good for emergency response.

Given the unique objectives and expectations of this project, a hybrid of the workshop and tabletop formats was selected for the exercise. Benefits and desired outcomes of each exercise type are listed below:

Workshop

- Encourage coordination and collaboration among stakeholders
- Identify potential opportunities for better drought preparedness
- Identify and prioritize uncertainties in water resources planning.
- Build a specific product, such as a list of planning resources

Tabletop

- Familiarize and expand participant knowledge of drought impacts, mitigation, and adaptation strategies in the Basin
- Assess existing management and mitigation strategies and discover any gaps that might exist

2.2 Phase 2: Basin Study and Scenario Development

The goal of Phase 2 was to gather information and develop scenarios for the exercise. To achieve this, it was important to study past impacts of drought in the Basin and gain an understanding of existing regulations and strategies for managing water. To help prioritize specific drought impacts for scenario development, an online drought impacts

survey was administered to learn how people in the Basin have been impacted by drought in the past. The following groups were asked to respond:

- Republican Basin NRD managers and staff,
- Water suppliers
- Emergency Services Managers
- Individuals living or working the Basin
- Stakeholders from the Republican BWP process

The survey was open from May 24 to November 30, 2021, and available at https://go.unl.edu/rrbdimpacts. Areas of focus identified in the survey are listed in Table 2.

Table 2. Drought impact exercise areas of focus

Drought Impacts Category	**Drought Impact Areas of Focus**
Crop production	Water for irrigation, crop stress, crop disease and reduced crop yield
Livestock production	Reduced grazing, increased mortality, and increased animal stress
Domestic water supply	Water quality issues and low/dry well water level
Public health	Declines in air quality (due to dust, pollen or smoke), stress (mental health issues)
Households	Less water for gardens and increased power bills
Fire	Increased wildfires, property damage and bans on fireworks or controlled burns
Business and industry	Closed businesses and bankruptcy, reduction in production and sales
Recreation and tourism	Reduced water activities, public recreation areas closed and reduced hunting and fishing
Wildlife	Invasive plant and animal species, change in migration, wildlife foraging near people and wildlife disease or mortality

To learn more about how the Basin's NRDs use available tools and management strategies to manage and mitigate drought, a questionnaire was distributed to the four NRD managers. This questionnaire, with NRD manager responses, is attached as Appendix A.

Scenarios for the exercise were developed using information from the drought impacts survey, NRD questionnaire, 2021 Republican River Basin forecast, and data from other drought monitoring and management tools such as the Drought Atlas (NDMC, n.d.). At the time of the exercise, the Republican River Basin in Nebraska was in the midst of severe and extreme drought, according to the U.S. Drought Monitor (NDMC, 2022). Ranchers and farmers were experiencing problems caused by the drought. Devastating wildfires burned pastures and cropland, destroyed central pivot irrigation systems and fencing, and killed livestock. Some firefighters lost their lives or were badly injured. Gusty winds eroded topsoil, created dust storms, and closed highways.

To recognize the severity of the ongoing drought situation and the losses suffered by the communities, the exercise development team used a combination of real and hypothetical conditions to build the scenarios. Five scenarios were developed to provide a realistic set of conditions over a two-and-a-half-year period. Each scenario consisted of a map of the U.S. Drought Monitor, a Seasonal Drought Outlook, reservoir levels and a narrative. To encourage realistic conversations through the scenarios, participants were grouped according to their respective NRD. Scenario specific questions helped focus table and large group discussions.

The scenarios primarily focused on actions needed to maintain compact compliance, interactions between agencies, public communication, and identifying policy gaps. Additionally, the scenarios looked at other important aspects of drought resilience such as conservation dynamics, emergency response and economic stability. Each scenario session included a facilitated small group discussions where ideas were shared and recorded. Figure 4 summarizes the scenario conditions and discussion topics used for the exercise.

Scenarios Timeline for the Republican River Basin Drought Planning Exercise

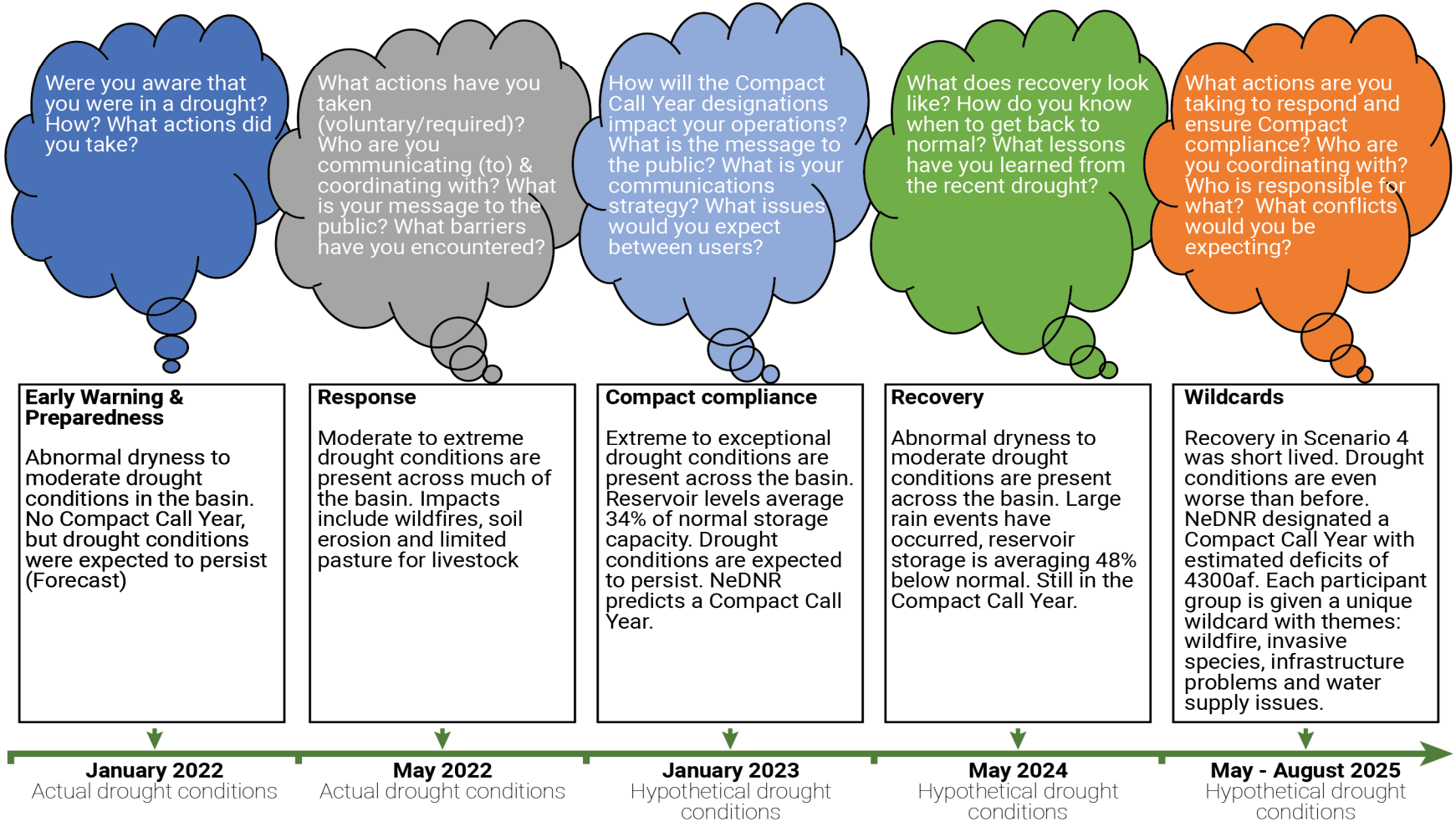

Figure 4: Scenario timeline for the Republican River Drought Planning Exercise

To ensure inclusive Basin representation in the exercise, a list of participants was developed, and invitation letters were sent. The list included:

- Republican Basin NRD staff and directors
- Municipal water suppliers
- Farmers and ranchers
- Rural water districts
- Business owners/representatives
- Emergency Management Professionals
- Nebraska Department of Natural Resources staff and director
- Irrigation Districts
- Nebraska Department of Environment and Energy
- US Bureau of Reclamation
- Nebraska Department of Agriculture

3.0 Drought Planning Exercise Event: Phase 3A

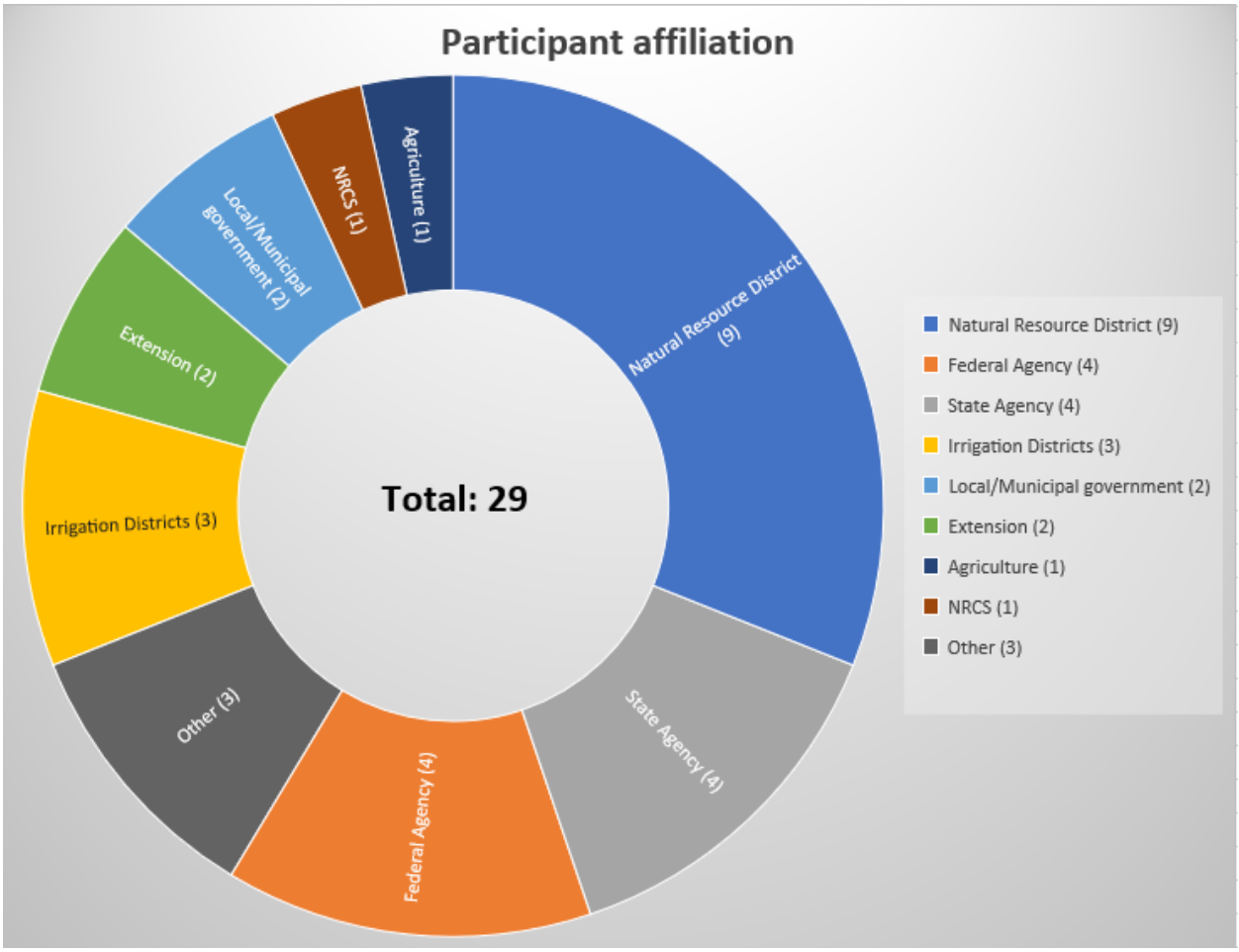

Figure 5: Participant affiliation in the Basin by sector/agency

The Republican River Basin drought planning exercise event was held on May 19th, 2022, at the Cambridge Community Center in Cambridge, NE. The event agenda can be found in Appendix B. The exercise was attended by 29 participants with various affiliations from across the Basin. These included agricultural producers, NRDs, Nebraska Extension, irrigation districts, local/municipal government, state agencies, federal agencies, Natural Resource Conservation Service (NRCS), and others (Figure 5). Participants were assigned to tables representing each NRD and were asked to engage in the exercise from the perspective of their assigned NRD.

For each of the five scenarios, participants were presented with a set of conditions, a list of problems, and some questions to help facilitate discussion. The NRD groups were then given 15 minutes to talk about the scenarios and record key points of discussion. At the

end of each scenario discussion, each of the groups reported back to the large group where ideas were shared, discussed and recorded.

At the end of the event, a wrap-up session was also conducted to capture major themes and identify potential actions moving forward. Each discussion group was facilitated by staff from the NeDNR.

4.0 Drought Planning Exercise Outcomes/Evaluation: Phase 3B

A total of 29 participants representing various sectors in the Basin participated in the exercise. At the event, participants were asked to fill out pre-event and post-event surveys. Out of a total of 29 survey pairs handed out, 26 pre-event and 22 post-event surveys were completed and turned in. The purpose of the surveys was to assess and evaluate the efficiency of the exercise in achieving set goals. Pre-event and post-event survey results can be found in Appendix C.

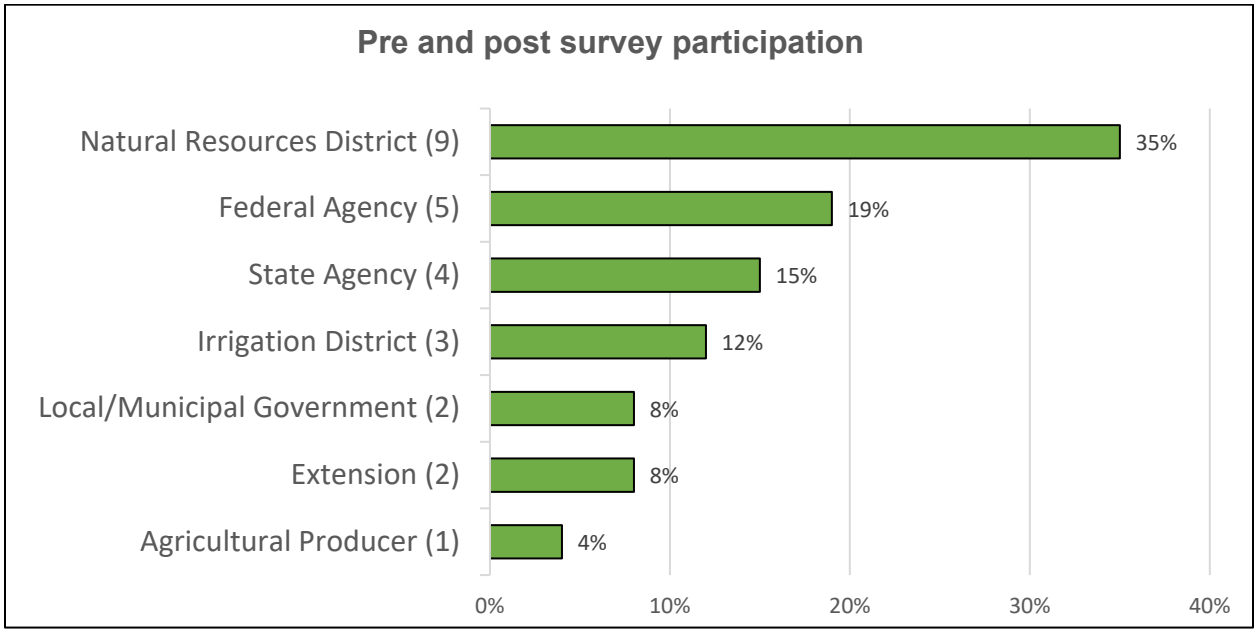

Figure 6: Survey participation by sector/agency

4.1 Survey Outcomes

Before the exercise, participants had a fair understanding of drought and the associated impacts in the Basin. All participants were familiar with and already using at least one of the drought monitoring metrics available in the Basin. An overview of the results is presented below.

Participants were generally the least familiar with:

- “How to plan for hazards such as drought” (42% not at all or slightly familiar)
- “How drought is managed with regard to compact compliance in the Republican River Basin” (43% not at all or slightly familiar)

Participants were generally the most familiar with:

- “Where to find resources that can help or inform me or my organization during drought” (89% moderately or extremely familiar)
- “My role (or my organization’s role) during drought” (77% moderately or extremely familiar)
- “How to manage during drought to minimize impacts or harm” (73% moderately or extremely familiar)
- “What I (or my organization) can do to aid compact compliance and reduce conflicts during drought” (73% moderately or extremely familiar)

When asked what their expectations were for the exercise, participants expected to:

- Learn about drought and associated impacts, resources available, regulations that must be followed so they can improve drought preparation in the Basin
- Identify weak points and collaboration opportunities related to drought management in the Basin
- Learn about their personal/organizational responsibilities for drought management and establish good lines of communication in the Basin
- Brainstorm ideas that may be helpful in time of drought
- Learn to make informed decisions on resource management during drought and work with multiple agencies to coordinate education outreach in the Basin
- Network, meet new people, learn new ideas and perspectives

After the exercise, participants were more knowledgeable about various drought issues in the Basin. For instance, participants were more decisive in their responses to questions about Basin drought preparedness in the post-survey compared to the pre-survey. Before the exercise, about 20% of the participants responded with “I don’t know” whereas, after the exercise, no participant responded with “I don’t know” (Figure 7).

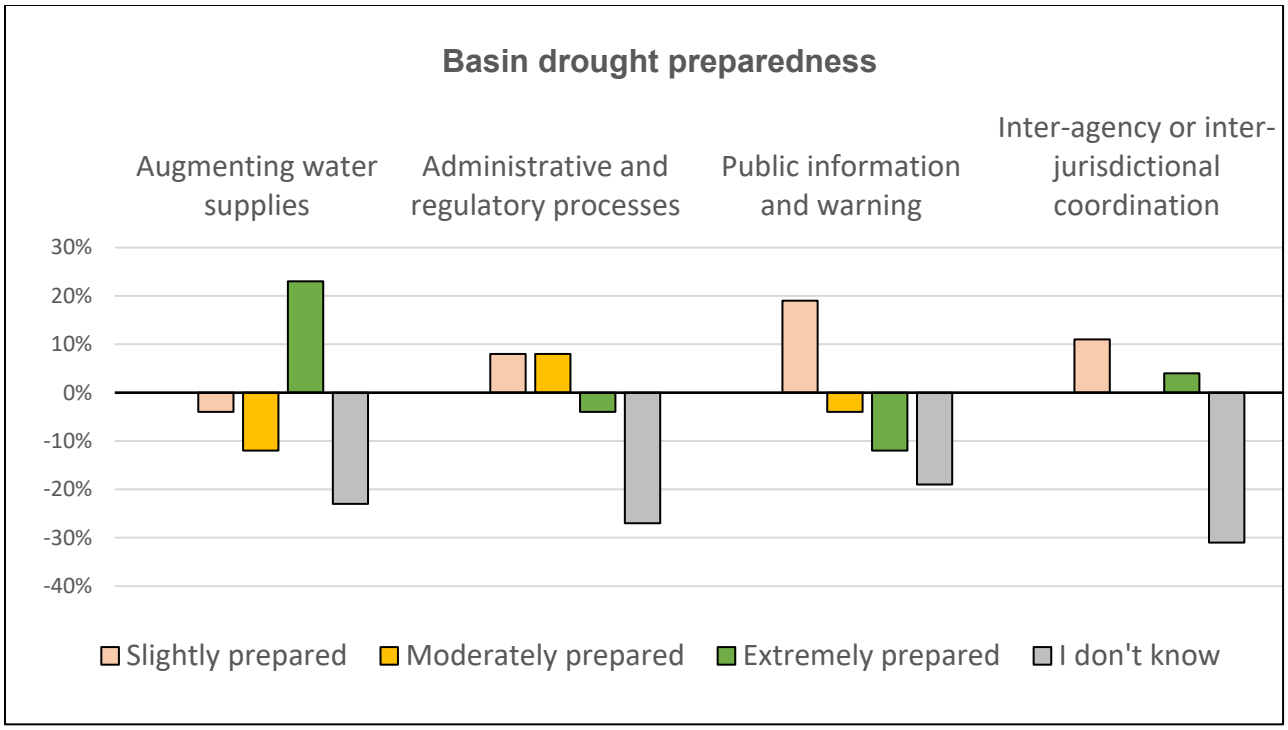

Figure 7: Percent difference between pre-exercise and post-exercise survey responses on drought preparedness. Positive numbers represent an increase from pre-exercise survey responses to post-exercise survey responses; negative numbers represent a reduction from pre-exercise survey responses to post exercise survey responses.

At the beginning of the exercise, most participants were somewhat or moderately satisfied with communication and coordination among agencies/organizations, and moderately satisfied with communication to the public in the Basin. After the exercise, more participants indicated they were “Not at all satisfied” with communication and coordination among agencies in the Basin. This result indicates the exercise provided participants with sufficient information to shift their opinions on the status of drought communication and coordination in the Basin (Figure 8).

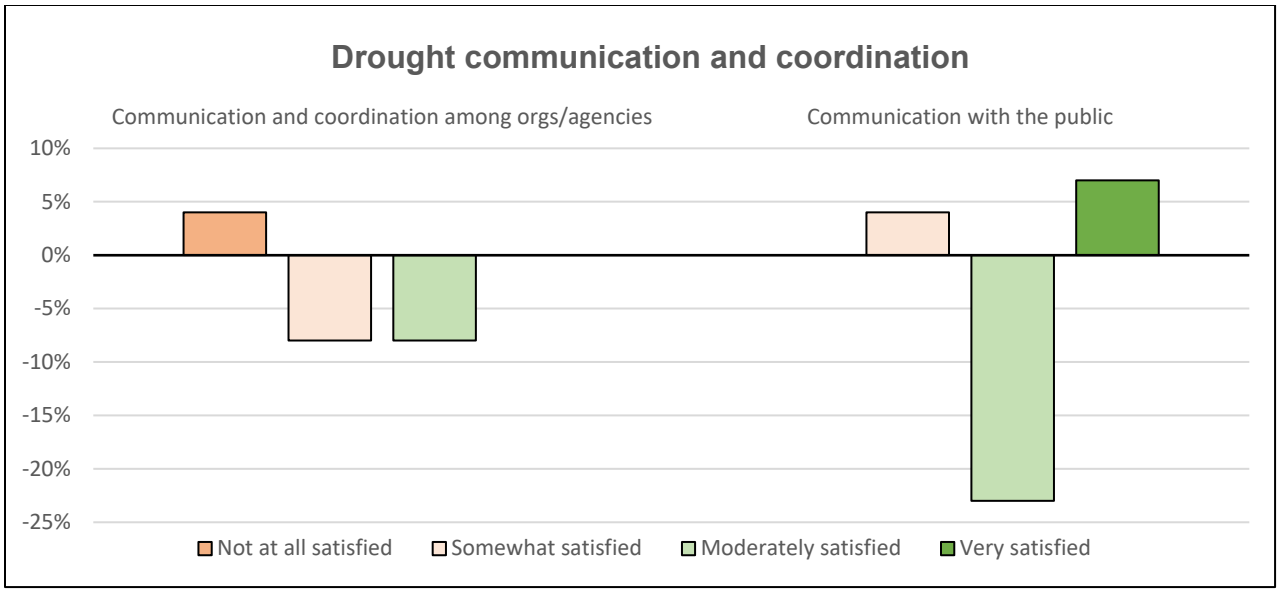

Figure 8: Percent difference between pre-exercise and post-exercise survey responses on drought communication and coordination. Positive numbers represent an increase from pre-exercise survey responses to post-exercise survey responses; negative numbers represent a reduction from pre-exercise survey responses to post exercise survey responses.

4.2 Exercise Outcomes

At the end of all the scenario discussions, participants came together for the wrap-up session where they shared lessons learned from the exercise and discussed potential future courses of actions. Based on discussions from the wrap-up sessions and survey responses, the following were the outcomes of the exercise:

- Increased knowledge of the following:
    - Personal and organizational responsibilities during drought in the Basin
    - How existing policy, developed to ensure compliance with the Republican River Compact and district IMPs, is implemented in times of drought to protect surface water and groundwater
    - Resources available during drought
- New relationships were built from interactions during the drought exercise event.
- A realization of the following:
    - There is interest in a Basin-specific drought dashboard and drought plan. These tools would help improve drought monitoring, response, and communication between agencies/organizations and the public in the Basin.

- There is interest in exploring more water conservation options that could increase water availability during drought in the Basin.

The following potential courses of actions were identified:

- If staff and resources are available, develop a Basin-specific drought plan that will outline clear resource management guidelines and establish lines of communication and coordination between agencies and to the public.
- If staff and resources are available, develop a Basin-specific drought dashboard that will help track and monitor drought triggers.

5.0 Future Planning Actions

Based on the outcomes of the exercise and conversations with the NRD managers, and depending on available staff and resources, future plans are:

5.1 Develop a Basin-Specific Drought Plan

In this context, a drought plan is a written document that will include strategies that the Basin will implement before, during and after a drought event. Development of a drought plan is dependent on availability of staff and resources. The proposed drought plan will be specific to the Republican River Basin in Nebraska and will include the following:

- **Communications Planning**
  - Develop strategies for better communication among stakeholders, SW & GW users and the public during droughts and ensure the abovementioned groups understand how and why NeDNR and the Republican NRDs maintain compact compliance.
  - Coordinate with emergency management agencies and rural fire departments to better mitigate and respond to wildfires and natural disasters.
  - Leverage outside funding sources, such as federal grants, for projects and programs to better mitigate and respond to drought and increase drought resiliency in the basin.
- **Drought Dashboard**
  - Provide real time data to SW & GW users, the public and natural resource managers with basin specific drought information.
  - Provide irrigators with educational information or a practical decision-making tool.
- **Conservation Projects**

- Develop drought resiliency and mitigation projects which could benefit from federal/state funding.
- Develop projects or programs that improve public awareness and increase water conservation practices during drought.

6.0 Conclusion

The Republican River Basin Drought Planning Exercise project was successful. In no particular order, NeDNR, the NDMC, and the Republican Basin NRDs wish to thank and acknowledge the following for their commitment and support to this project:

- Nebraska Extension
- Irrigation districts in the Republican River Basin
- Local/Municipal governments in the Republican River Basin
- U.S. Department of Agriculture
- Nebraska Emergency Management Agency
- Agricultural producers in the Republican River Basin
- Natural Resources Conservation Service
- Mayor of the City of Cambridge

7.0 References

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Appendices

Appendix A: Responses to the NRD Questionnaire

1. What products, tools or services do you use to monitor drought conditions in your district?	
• High Plains Climate Center, national and regional drought maps • NERAIN rainfall data • NOAA climate Data • NeDNR/USGS stream gage data • US Drought monitoring tools from NDMC • National Weather service	• MAO Project • Groundwater modeling software • Local producer information • Local weather stations • Soil moisture data from automated soil moisture probes

2. What management actions have you used in the past to address drought in your district?
• Temporary groundwater transfers to supplement limited SW deliveries. • Monitoring of groundwater levels and streamflows. • Water Conservation Incentive Program: intended to improve drought resilience by reducing groundwater consumption. • Groundwater pooling agreements available to producers. • Multi-year allocations that allow irrigators to "bank" groundwater not used in wetter years so that it can be used during drought. • Hard cap on groundwater allocations during Compact Call years. • Dry year lease program • Reduction of consumptive use

3. What management actions do you anticipate using in the future, in the event of a significant drought?

- Considering whether it would be useful to use incentives or regulations to limit groundwater use by irrigators who have access to surface water in years when surface water is readily available. This could leave more groundwater available for use when surface water supplies are inadequate.
- Improve accessibility of drought related information to landowner through District website
- Hard Cap on groundwater pumping during Compact Call years.
- Modifications to rules and regulations that will encourage or require less water usage to promote adoption of more water-saving technology by producers, and better management of their 5-year allotment of water allocation
- Augmentation
- Building new storage facilities in designated watersheds for retiming of releases during drought conditions.
- Working to with UNL to develop real-time, field specific evapotranspiration estimates, and forecasts. New technologies can improve efficiencies.
- Agreements with NBID to transfer water into KS account in HCL when needed.

4. Who in your district do you communicate with regarding drought or water shortage issues?

- Irrigation districts
- Municipalities
- Rural water districts
- Industrial entities
- UNL Extension
- Well owners

Appendix B: Drought Planning Exercise Agenda

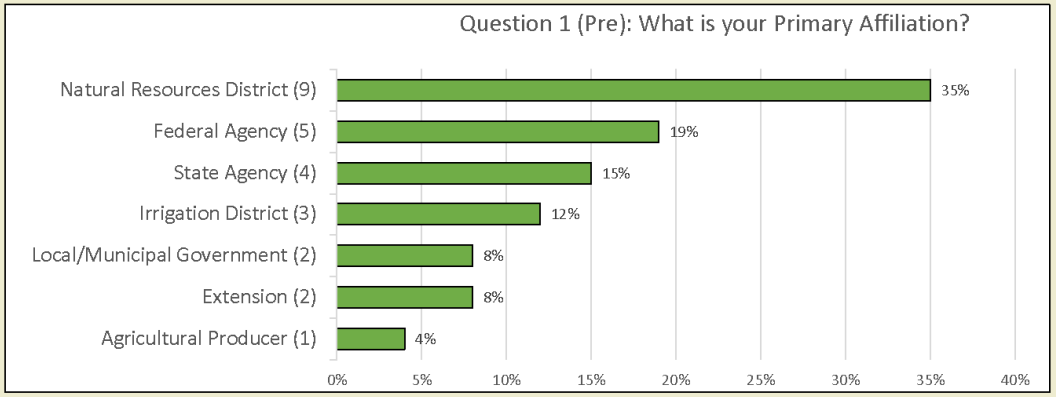
	Time	Description
Room preparations & participant arrival	8:00-9:00AM	
Pre-event survey	09:00-09:30AM	
Introductions & welcoming remarks	09:30-10:00AM	
Scenario 1: January 2022	10:00-10:20AM	Drought early warning & preparedness
Scenario 2: March 2022	10:20- 10:40AM	Drought response
Group discussion for scenarios 1&2	10:40-11:00AM	
Scenario 3:	11:00-11:30AM	Compact compliance in drought
Group discussion for scenario 3	11:30-11:50AM	
Working lunch	11:50-1:00PM	Presentation (WaterSmart Grant process)
Scenario 4:	1:00-1:20PM	Drought recovery
Group discussion for scenario 4	1:20-1:40pm	
Scenario 5:	1:40-2:00PM	Wildcards
Group discussion for scenario 5	2:00-2:20PM	
Wrap up session	2:20-2:40PM	What? So what?
Post-event survey	2:40-2:55PM	
Closing remarks	2:55-3:00PM	

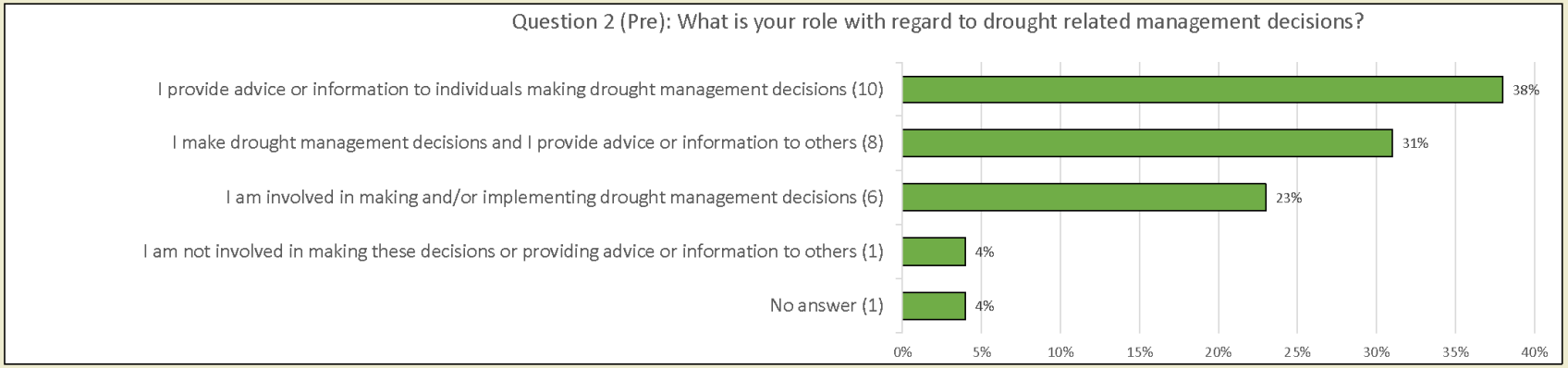
Republican River Basin Drought Exercise

Pre and Post Exercise Survey Results

Drought Exercise Participants

- In total, **26** pre-event and **22** post-event surveys were completed by Drought Exercise participants.
- About 1/3 of participants were affiliated with NRDs, 1/3 were from State or Federal agencies, and 1/3 were from other sectors (Irrigation districts, UNL Extension, Local/Municipal government).
- Most participants were decision makers, provided information/advice to decision makers, or both.

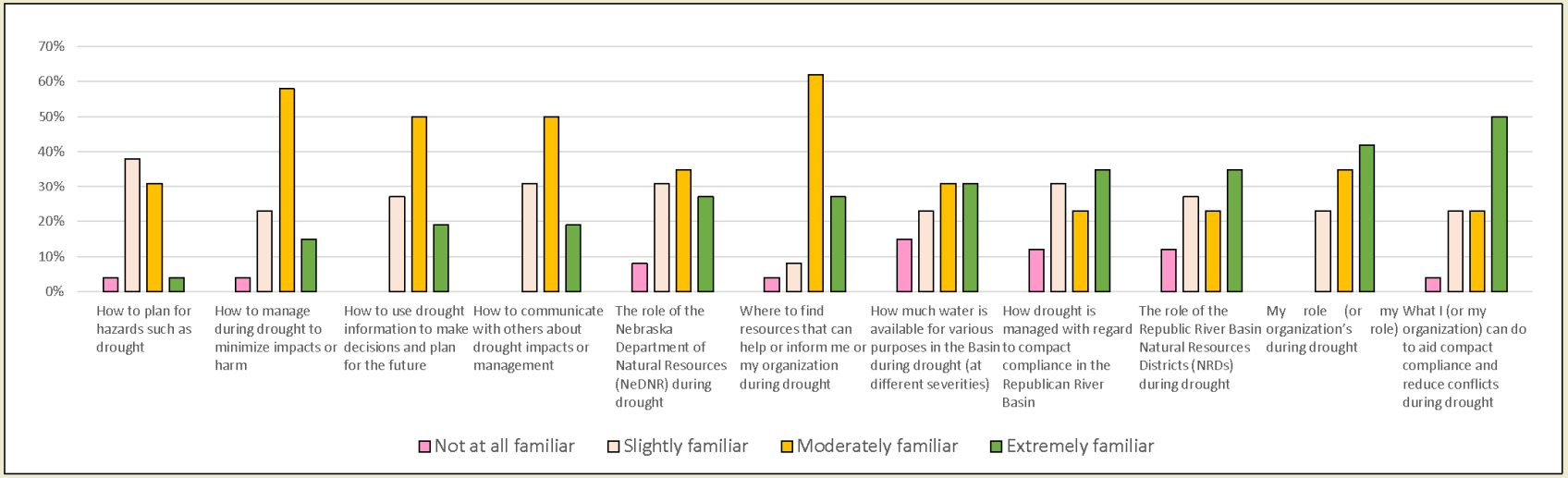




Q10 (Pre-Survey): Finally, in your opinion, what should the upcoming Drought Exercise accomplish?

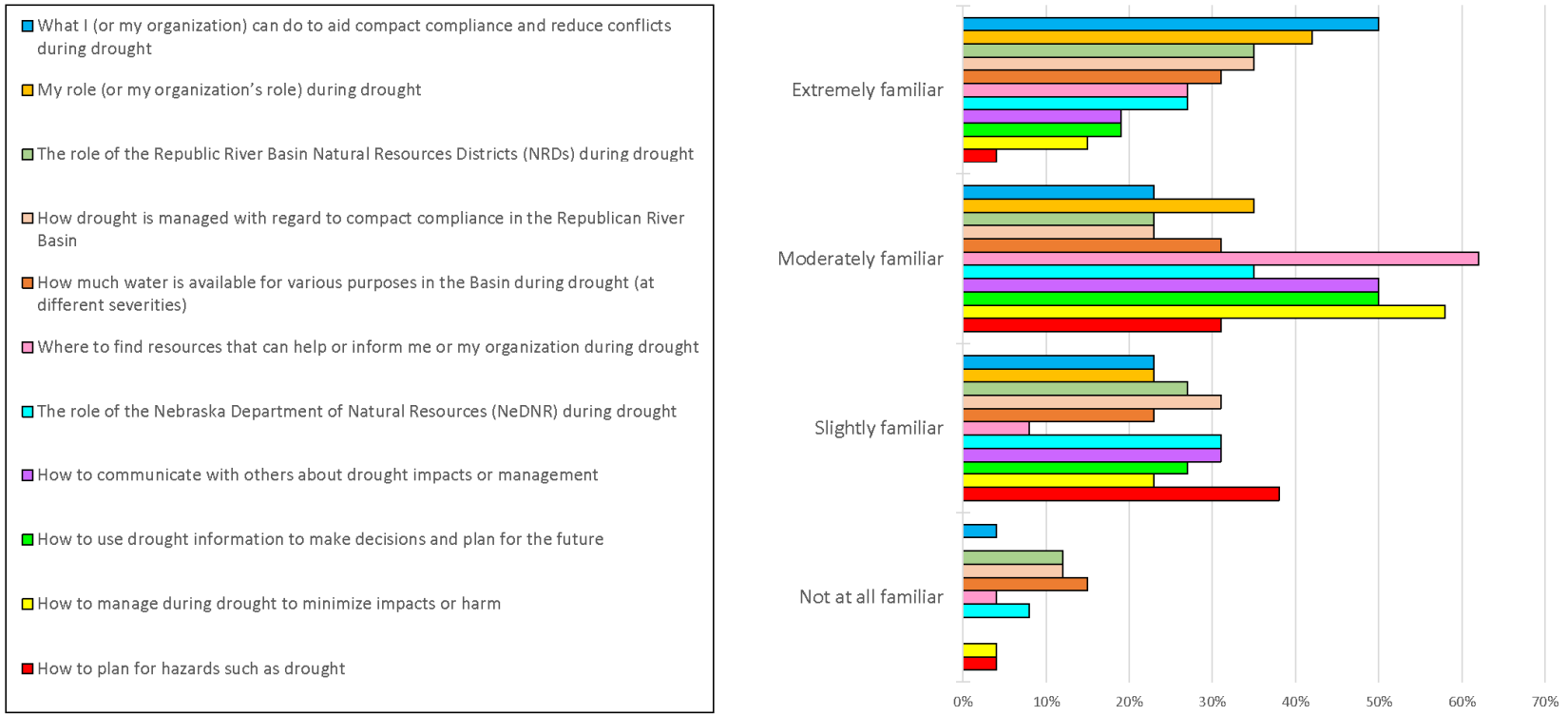
- Help us identify weak points and collaboration opportunities related to drought
- Discuss options for different levels of drought and where to find resources
- Learn about different agencies and what their roles maybe
- I am just here to learn
- Establish good lines of communication and what responsibilities each NRD are responsible for
- Improve drought preparation
- Better awareness of what is available and regulations that must be followed
- To brainstorm ideas that maybe helpful in time of drought
- Bringing players together and understanding the roles they play
- Understand everyone's role during drought
- Help make informed decisions on resource management during drought and work with multiple agencies to coordinate education outreach
- New ideas, different perspectives
- Preparation for long range projections

Q3 (Pre-Survey): How would you describe your level of familiarity with the following?

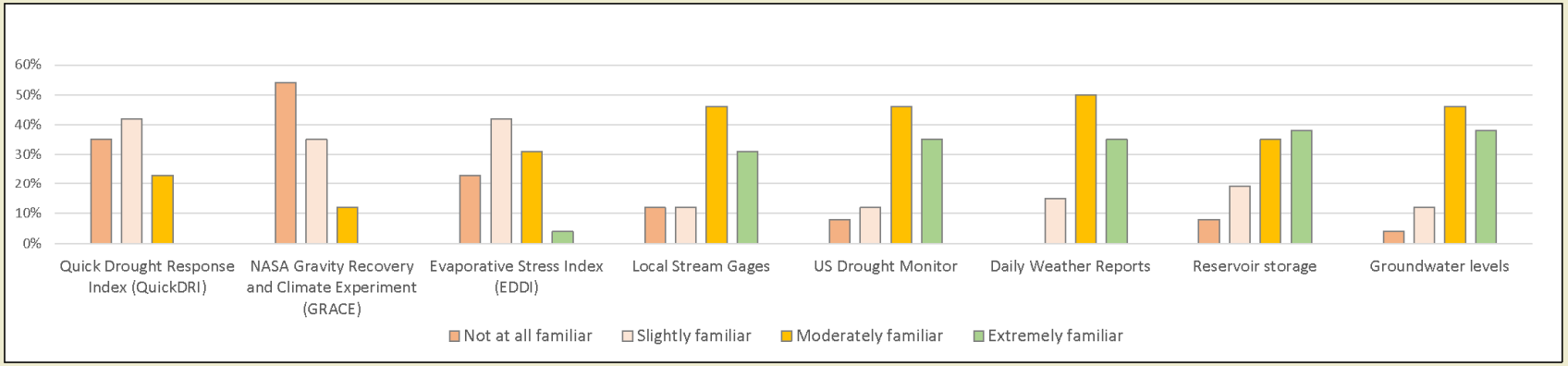


- Overall, familiarity with the above drought topics is evenly distributed.
- Participants were generally the least familiar with:
  - "How to plan for hazards such as drought"(42% not at all or slightly familiar)
  - "How drought is managed with regard to compact compliance in the Republican River Basin" (43% not at all or slightly familiar)
- Participants were generally the most familiar with:
  - "Where to find resources that can help or inform me or my organization during drought" (89% moderately or extremely familiar)
  - "My role (or my organization's role) during drought" (77% moderately or extremely familiar)
  - "How to manage during drought to minimize impacts or harm" (73% moderately or extremely familiar)
  - "What I (or my organization's) can do to aid compact compliance and reduce conflicts during drought" (73% moderately or extremely familiar)

Q3 (Pre-Survey): How would you describe your level of familiarity with the following?

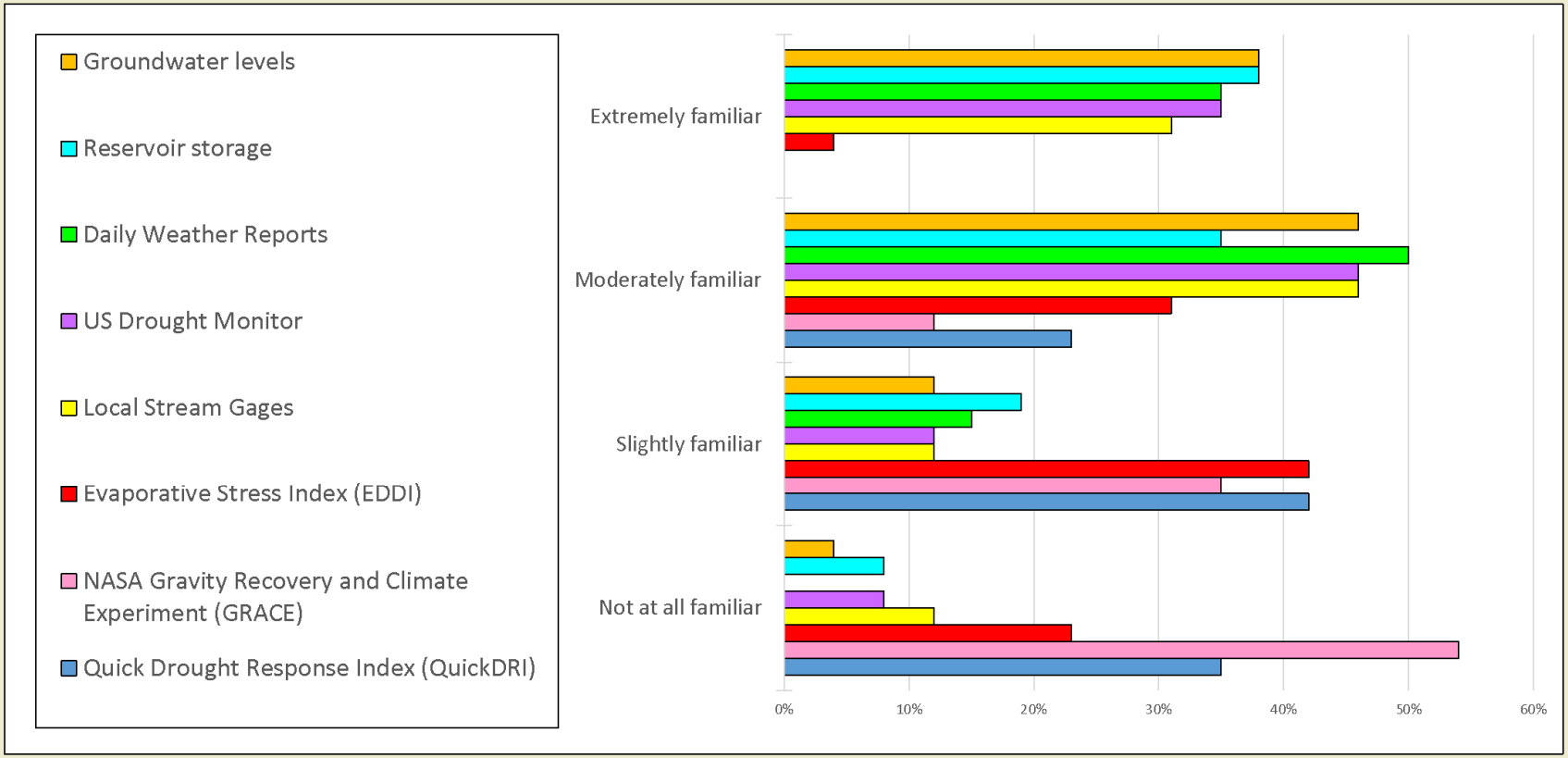


Q4 Pre-Survey: How familiar are you with using the following drought metrics?

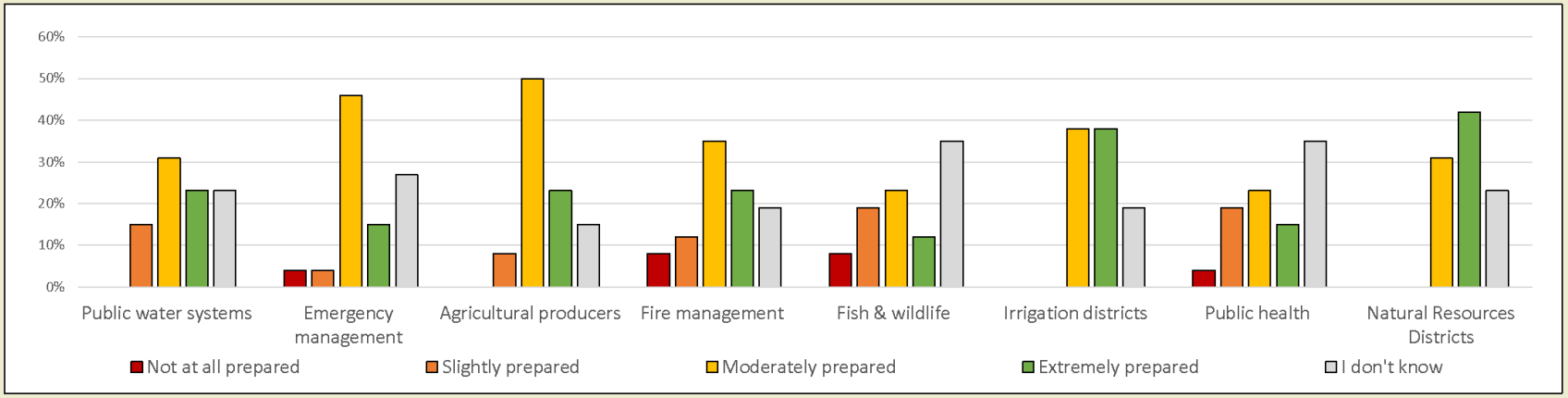


- Participants were generally the least familiar with:
  - GRACE (89% not at all or slightly familiar)
  - QuickDRI (77% not at all or slightly familiar)
  - EDDI (65% not at all or slightly familiar)
- Participants were generally the most familiar with:
  - Daily weather reports (85% moderately or extremely familiar)
  - Groundwater levels (84% moderately or extremely familiar)
  - US Drought Monitor (81% moderately or extremely familiar)

Q4 Pre-Survey: How familiar are you with using the following drought metrics?

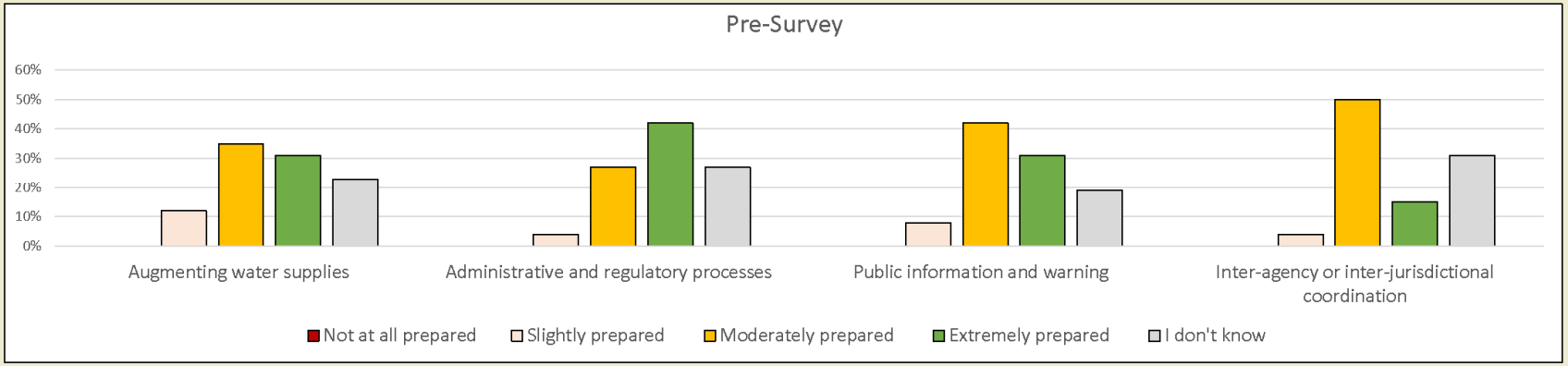


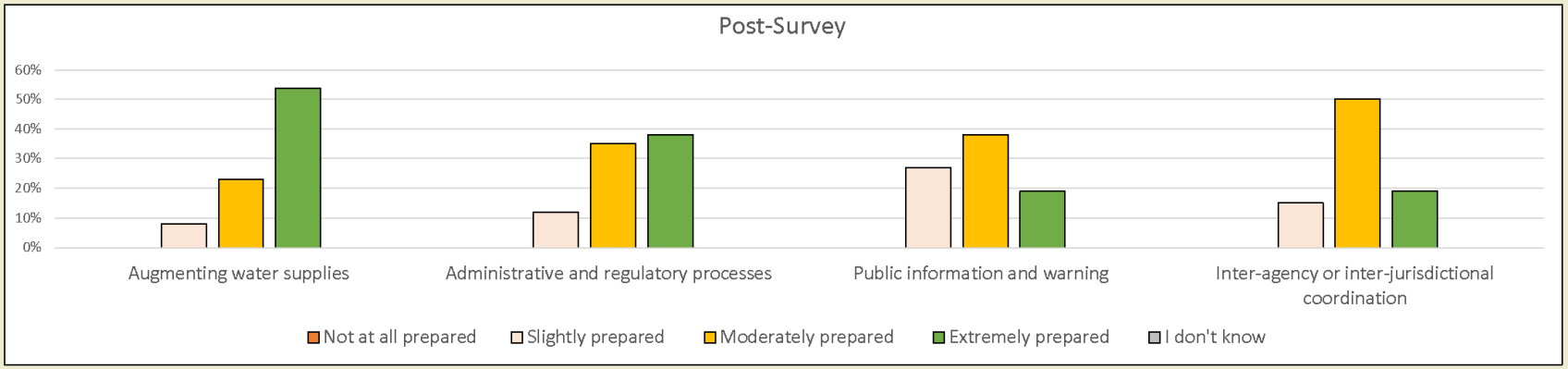
Q5 Pre-Survey: In your opinion, how prepared are the following sectors to deal with drought in the Republican River Basin?



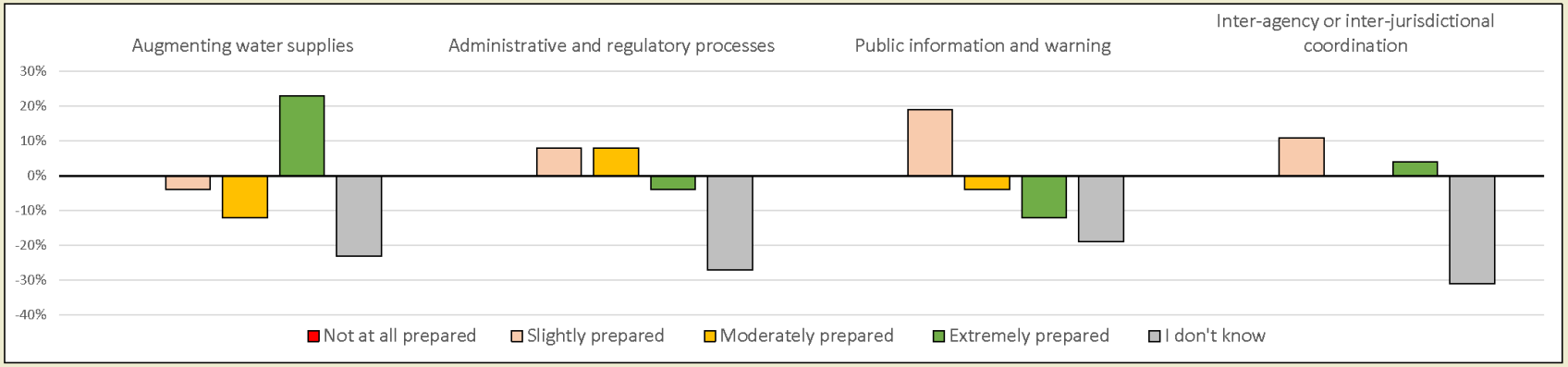
- In general, participants found the following sectors to be the least prepared for drought:
  - Fish & Wildlife (27% not at all or slightly prepared)
  - Public Health (23% not at all or slightly prepared)
  - Fire Management (20% not at all or slightly prepared)
- In general, participants found the following sectors to be the most prepared for drought:
  - Irrigation Districts (76% moderately or extremely prepared)
  - Natural Resources Districts (73% moderately or extremely prepared)
  - Agricultural Producers (73% moderately or extremely prepared)

Q6: In your opinion, how prepared is the Republican River Basin to do each of the following in case of severe drought?



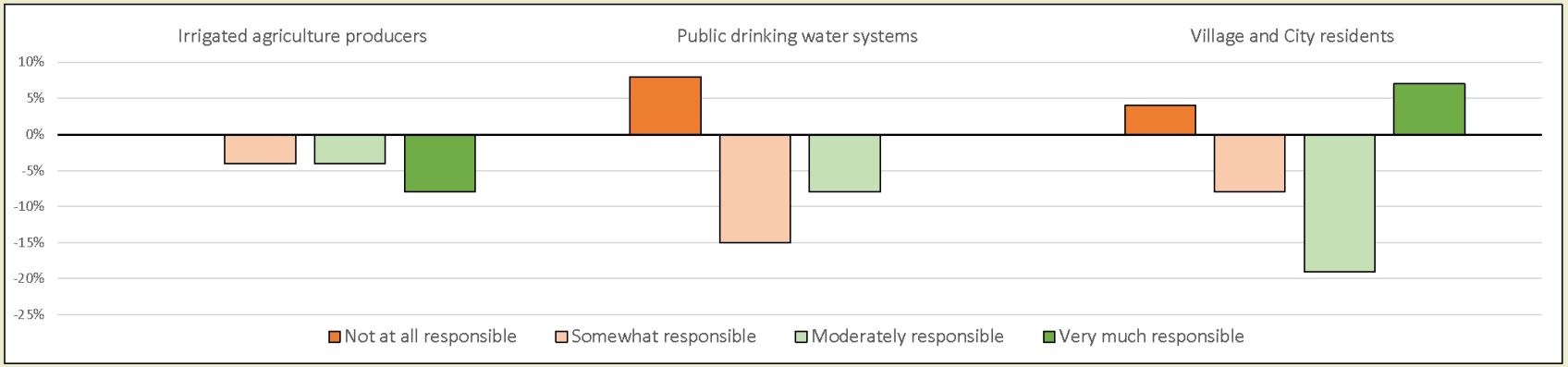


Q6 (change): In your opinion, how prepared is the Republican River Basin to do each of the following in case of severe drought?



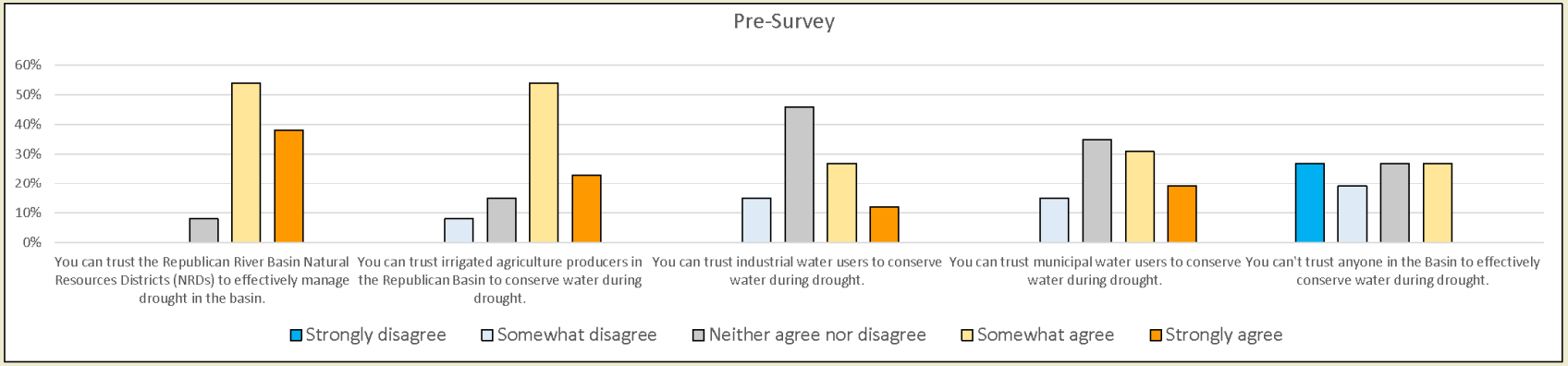
- After the exercise, participants were more decisive in their answers to question 6.
  - There were no "I don't know" answers to question 6 in the post-survey, which indicates that the exercise impacted how participants felt about the above actions.
- Following the exercise, participants felt that the Basin was most prepared to address drought by augmenting water supplies.
- Participant opinions about administrative and regulatory processes, and inter-agency/inter-jurisdictional coordination didn't change much as a result of the exercise.
- Participant opinions about public information and warning preparedness decreased in the "moderately prepared" and "extremely prepared" categories and increased for the "slightly prepared" category.

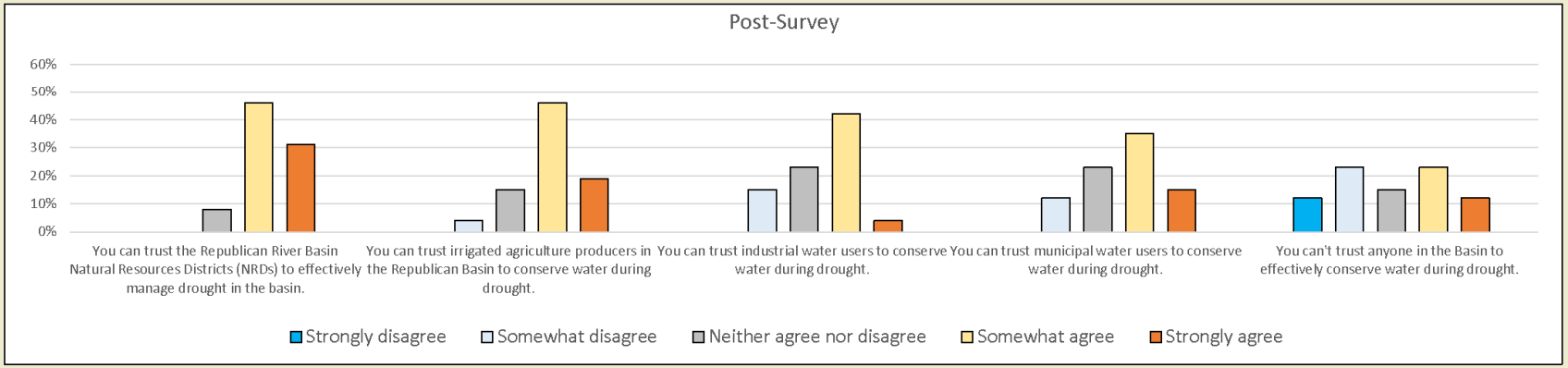
Q7 (Change): To what extent do you think each of the following groups should be responsible for conserving water during drought in the Basin?



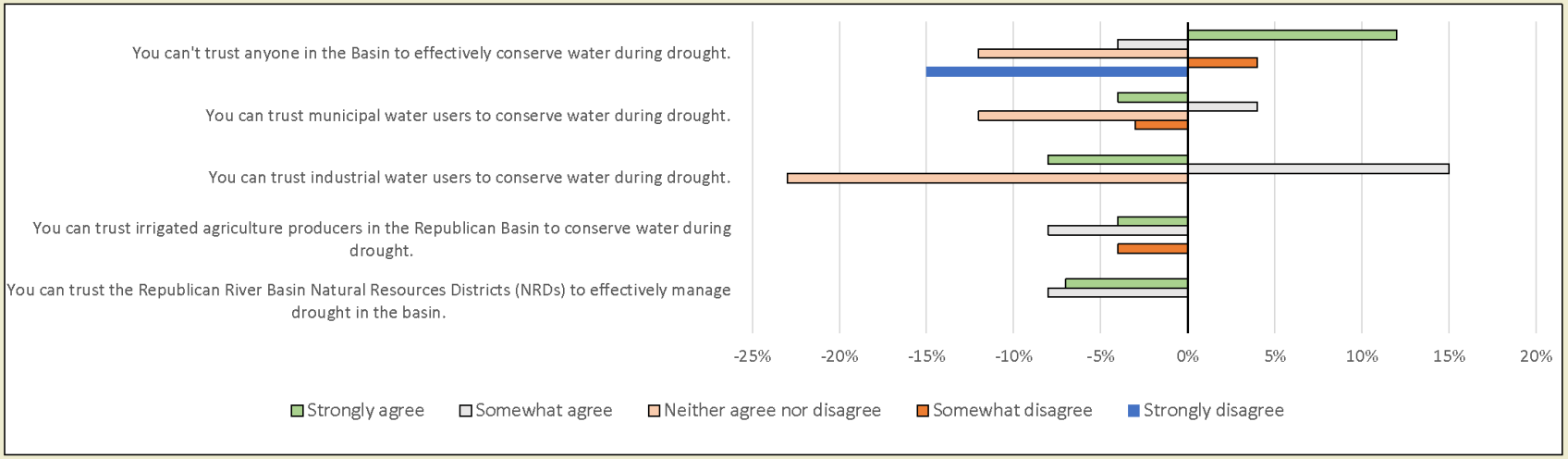
- Only 85% of survey respondents answered question 7 on the post-event survey. This accounts for much of the change between surveys.
  - The perception that public drinking water systems are “not responsible at all” increased by 8%
  - The perception that village/city residents are “not responsible at all” increased by 4%
  - The perception that village/city residents are “very much responsible” increased by 8%

Q8: In general, to what extent do you agree or disagree with the following statements?



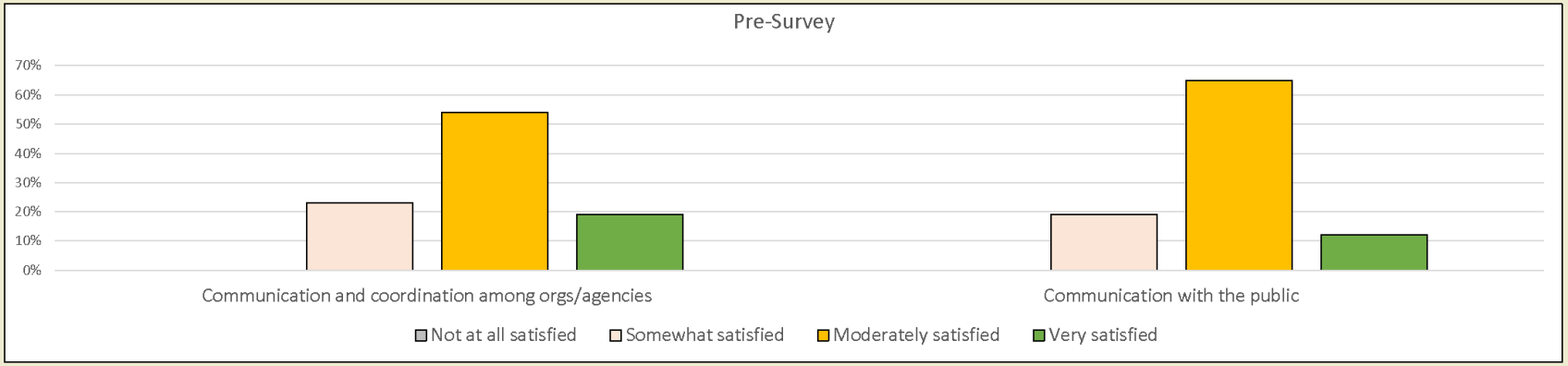


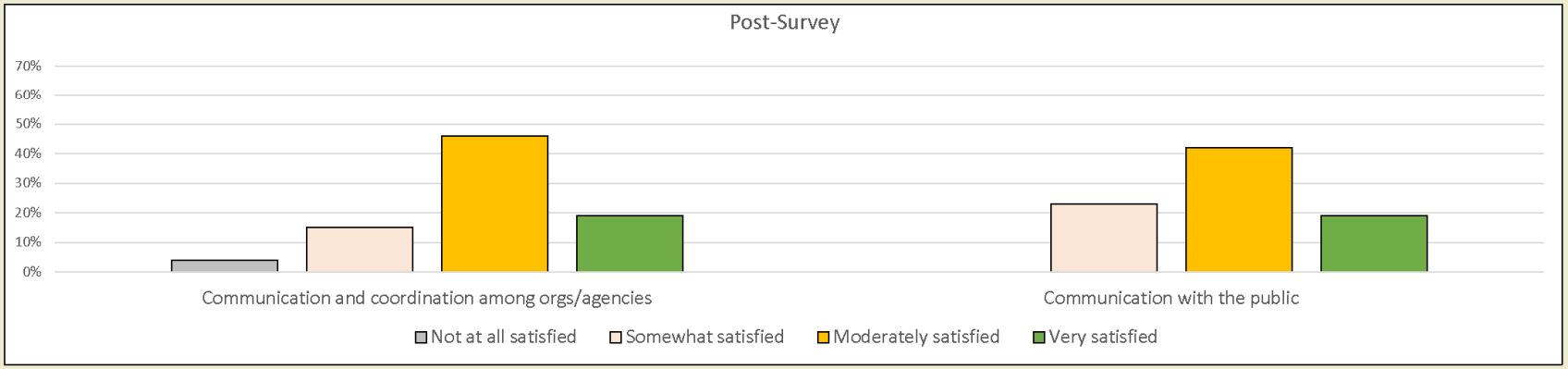
Q8 (change): In general, to what extent do you agree or disagree with the following statements?



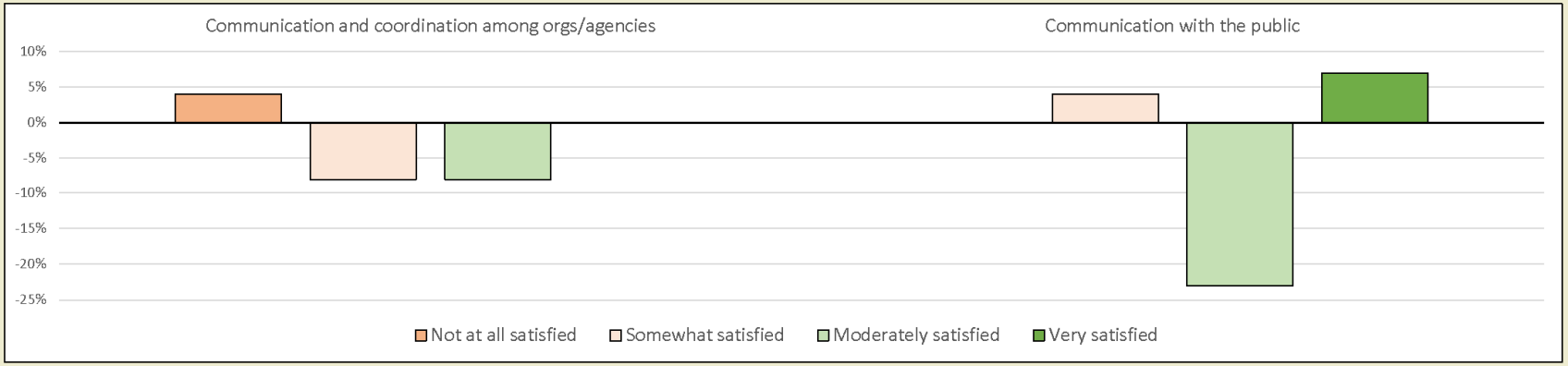
- Only 85% of survey respondents answered question 8 on the post-event survey. This accounts for much of the change between surveys.
  - Notable changes between surveys include:
    - There was a 12% increase in respondents indicating that they "strongly agree" with the statement "You **can't** trust anyone in the Basin to effectively conserve water during drought".
    - There was a 15% increase in respondents indicating that they "somewhat agree" with the statement "You **can** trust industrial water users to conserve water during drought".

Q9: How satisfied are you with communication and coordination between agencies, organizations and the public with regard to drought management in the Republican River Basin?



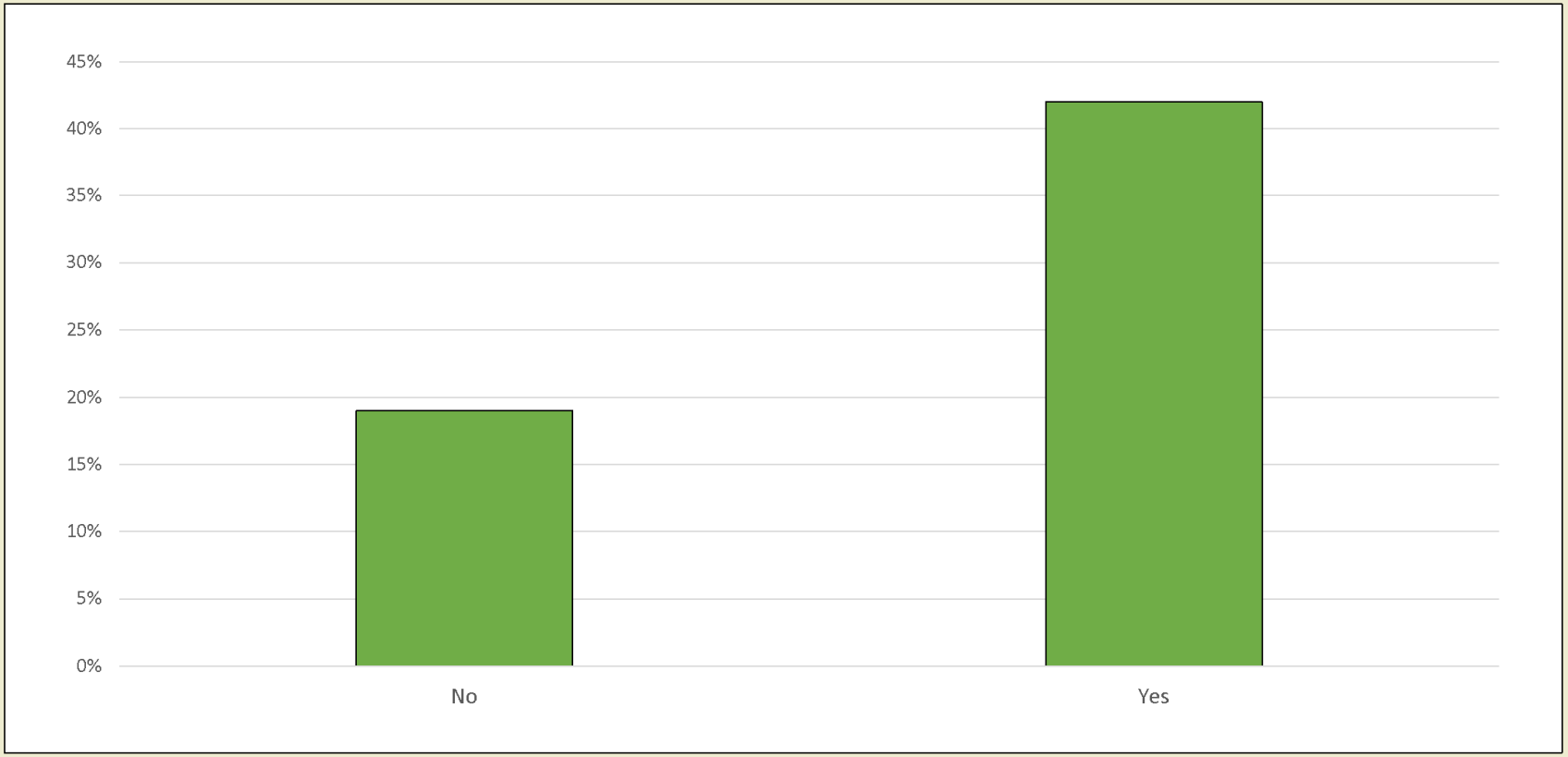


Q9(change): How satisfied are you with communication and coordination between agencies, organizations and the public with regard to drought management in the Republican River Basin?

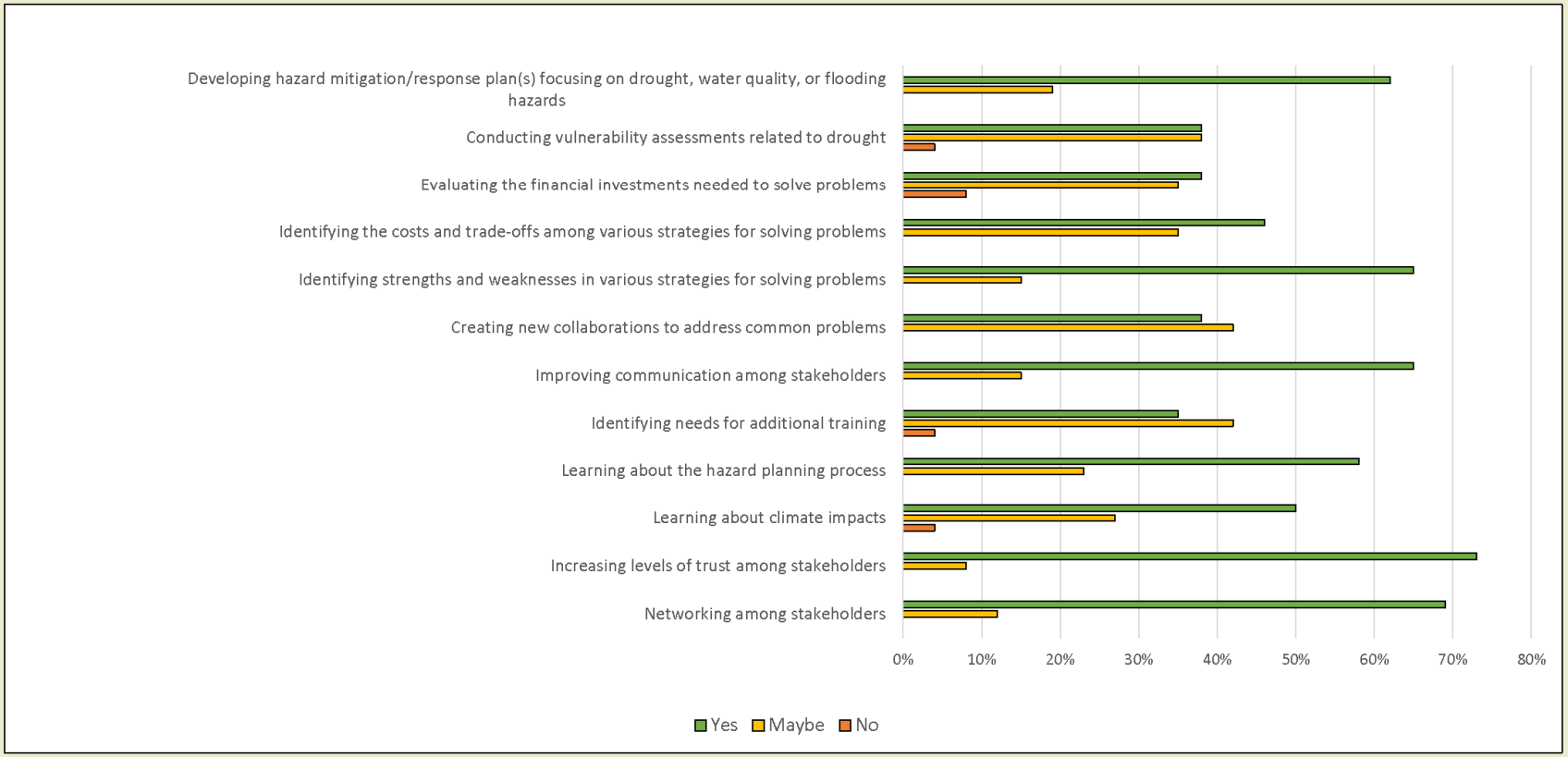


- Only 85% of survey respondents answered question 8 on the post-event survey. This accounts for much of the change between surveys.
  - Notable changes between surveys include:
    - There was a 4% (1 participant) increase in respondents reporting that they are 'Not at all satisfied" with "Communication and coordination among orgs/agencies.
    - There was an 8% increase in respondents reporting that they were 'Very satisfied" and a 4% increase in those reporting that they are "Somewhat satisfied" with "Communication with the public"

Q10 (Post-Survey): Did the scenario exercise identify or reinforce lines of communication that are more satisfactory to you?



Q11 (Post-Survey): Based on your experience, would you recommend the use of a scenario exercise for the following purposes?



Attachment E

Republican Basin: Compact Call Year Decision Timeline

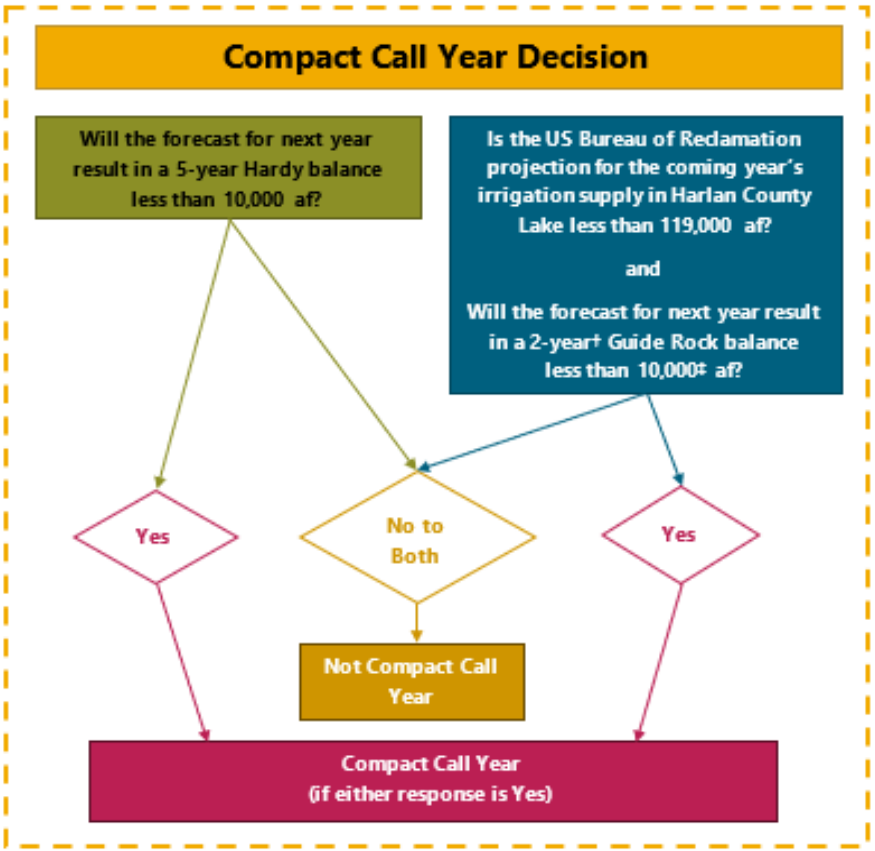


Figure 1. Compact Call Year Decision

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.