First Five-Year Technical Analysis for the Republican River Basin-Wide Plan

Results and Plan Progress Updates, 2019-2022

Executive Summary

Introduction

As required by Neb. Rev. Stat. § 46-755(1), a basin-wide plan (Plan) for the Republican River Basin (Basin) was jointly developed by the Nebraska Department of Natural Resources (NeDNR) and the Natural Resources Districts (NRDs) in the Basin. This Plan became effective on March 1, 2019. For further information, see the Introduction section of the approved Plan and full report below.

Neb. Rev. Stat. § 46-755(5)(d) requires NeDNR and the Basin NRDs (Upper Republican NRD (URNRD), Middle Republican NRD (MRNRD), Lower Republican NRD (LRNRD), and Tri-Basin NRD (TBNRD)) to conduct a technical analysis of the actions taken in the river basin to determine progress towards meeting the objectives of the Plan within five years of Plan adoption, and every five years thereafter.

Due to the nature of data collection and approval under the RRCA, and the statutory timeframe in which the Analysis was to be conducted, only four years of data (2019-2022) were available for evaluation. The subsequent Five-Year Technical Analysis, to be completed by the end of 2028, will include evaluation of a full 5 years of data (2023-2027).

Analysis Results

Measurable Hydrologic Objectives

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

For the URNRD, MRNRD, and LRNRD, net groundwater depletions to streamflow are within the limits specified in the Monitoring & Studies Technical Memorandum attached to their IMPs. For TBNRD, the net effect to baseflow was positive on a three-year rolling average throughout the Analysis Period (2019-2022). This MHO is assessed annually.

Table 1. Summary of MHO A evaluation results for all Basin NRDs during the Analysis Period.

Key to Possible Test Results	Year	URNRD	MRNRD	LRNRD	TBNRD
MHO is being achieved. NRD's actual depletions were within its allowable depletions. No further discussion is needed.	2019	●	●	●	●
	2020	●	●	●	●
MHO is not being achieved. NRD's actual depletions exceeded its allowable depletions. Discussion of next steps is required.	2021	●	●	●	●
	2022	●	●	●	●

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.

Groundwater depletion values (from approved RRCA accounting) for each of the Republican NRDs were statistically analyzed using the Mann-Kendall Trend Test. For TBNRD, the same analyses were run while factoring in the mound credit at the district's southern boundary. In an attempt to isolate effects of groundwater pumping, the potential influence of precipitation trends, undepleted baseflow, and virgin water supply were controlled for (decorrelated) in multiple runs of this test.

Table 2. Mann-Kendall Trend Test results for unmodified and decorrelated depletions and associated MHO B evaluation result. Depletions from 2008 – 2022 were analyzed for UR/MR/LRNRD, and net depletions from 2013 – 2022 were analyzed for TBNRD.

MHO B Test Results			
MHO is being achieved. No trend or 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.			
URNRD	**MRNRD**	**LRNRD**	**TBNRD**
●	●	●	●

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.

Spring groundwater levels of basin wells were statistically analyzed using the Mann-Kendall Trend Test to identify any areas containing wells with groundwater levels declining at such a rate that there will not be enough groundwater available for all groundwater uses within the timeframe of the Plan. If any such areas are identified, further management actions may be needed. This analysis constitutes the first phase of screening for compliance with MHO C. As described in the Plan, the second and third phases will be conducted in upcoming years.

Table 3. Mann-Kendall Trend Test results for spring groundwater levels from 2008-2022 for UR/MR/LRNRD, and from 2013-2022 for TBNRD.

Natural Resources District	Wells with Increasing/No Trend	Wells with Decreasing Trend
URNRD	86	198
MRNRD	93	30
LRNRD	348	19
TBNRD	117	1

*Only the wells in publicly available United States Geological Survey (USGS) and University of Nebraska-Lincoln Conservation and Survey Division (CSD) datasets were included in this analysis.

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

Throughout the Analysis Period, there was no curtailment of groundwater pumping within the Special Response Area for Compact compliance.

Table 4. Summary of MHO D evaluation results for UR/MR/LRNRD during the Analysis Period.

Key to Possible Test Results	Year	URNRD	MRNRD	LRNRD
MHO is being achieved. NRD did not curtail groundwater pumping within the Rapid Response Area to ensure Compact compliance. No further discussion needed.	2019			
	2020			
MHO is not being achieved. NRD curtailed groundwater pumping within the Rapid Response Area to ensure Compact compliance. Discussion of next steps is required.	2021			
	2022			

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. Any administration that is automatically triggered under the terms of the Final Settlement Stipulation (FSS) is not evaluated as part of MHO E. Throughout the Analysis Period, no surface water administration was needed to ensure Compact compliance.

Table 5. Summary of MHO E evaluation results for UR/MR/LRNRD during the Analysis Period.

Key to Possible Test Results	Year	Result
MHO is being achieved. NeDNR did not administer surface water to ensure Compact compliance, except as required under the FSS. No further discussion needed.	2019	
	2020	
MHO is not being achieved. NeDNR administered surface water to ensure Compact compliance. Discussion of next steps is required.	2021	
	2022	

Action Item 2.5.2: Analyzing Lag Time of Streamflow Depletion from Groundwater Pumping

To fulfill Action Item 2.5.2 of the Plan, the RRCA groundwater model was used to analyze future impacts of past groundwater pumping (residual effects) in the Basin. This analysis was intended to answer the question, "if groundwater pumping in the Basin were to stop completely, how long would it take streamflow to recover (i.e., return to a condition with no pumping-related stream depletions)?" Results of this analysis indicate if groundwater pumping were to stop completely, residual depletions from past pumping would continue through the end of the Plan timeframe (2044).

Available Supplies, Current Uses, & Changes in Long-Term Water Availability

The water supply available for consumptive use in Nebraska is limited to the State's allocation under the Compact. Throughout the Analysis Period, Nebraska remained within its allocation for the applicable averaging period (e.g., for 2022, 'Average 2018-2022' in Table 6 below). The major consumptive uses of water in the Basin include groundwater pumping for irrigation and municipal/industrial use, surface water diversion for irrigation, and reservoir evaporation. The MHO analyses shown above did not identify any definitive trends in water availability. The water conservation projects and practices implemented under the Plan are expected to improve long-term water availability in the Basin.

Table 6. Approved summary RRCA accounting data for Nebraska from 2018-2022 (all values in acre-feet).

Year	Allocation (Col 1)	Computed Beneficial Consumptive Use (Col 2)	Imported Water Supply Credit and Nebraska Resolution Water Supply Credit (Col 3)	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit and NERWS Credit Col 1 – (Col 2- Col 3)
2018	241,680	266,080	25,943	1,543
2019	389,300	262,870	26,541	152,971
2020	303,070	252,400	18,995	69,665
2021	258,180	252,650	21,456	26,986
2022	221,860	249,960	16,157	-11,943
Average 2018-2022	282,820	256,790	21,820	47,840

Action Item 2.7.1 Analysis of Surface Water Allotment and Groundwater Allocation Systems Impact

Surface water and groundwater users both maximize their beneficial use of the available water supply (state allocation) under the current allotment/allocation systems. Controls are in place to curtail both groundwater pumping and surface water diversions during Compact Call Years. Surface water and groundwater users are both required to meter their use and remain within allowable amounts of total use to ensure Compact compliance is maintained.

Action Item 2.7.2: Recommended Changes to Surface Water Allotment and Groundwater Allocation 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.

Effects of Conservation Practices and Natural Causes

A literature review of conservation practices and their impact on streamflow was conducted as further described in the full report below. A summary of the conservation projects implemented in the basin during the Analysis Period can be found on pages 21 to 25 of the full report and in the table below.

Table 7. Conservation projects, associated funding sources and amounts, and estimated water savings.

Project/Practice	Local Funds	State Funds	Federal Funds	Estimated Water Savings
CREP	—	—	—	121,585 AF
Decertification of Irrigated Acres	$ 3,514,421.62	$ 5,250,432.56	—	46,218 AF
Improved Irrigation Efficiency	$ 2,427,433	$ 2,635,576	$2,800,000	39,529 AF/year
Improved Canal System Efficiency	$ 849,949	$ 5,077,593	$ 3,575,000	8,079 AF/year

The effects of natural causes such as drought on water availability and Compact compliance were analyzed and discussed among basin stakeholders during the Republican River Drought Planning Exercise held in 2022. See the full report for further information on potential impacts of natural causes on Compact compliance during the Analysis Period.

Progress Made Under Plan

The progress made towards achieving the goals and objectives of the Plan was analyzed annually as described in the Plan annual reports, which can be found on the Plan website. Objectives to be completed every five years for the Analysis were analyzed as described in this report and will continue to be analyzed every five years hereafter.

Overall, Plan implementation has been successful in achieving the goals of maintaining Compact compliance while maximizing Nebraska's beneficial use of the available water supply and taking steps to ensure the stability of that supply over the long term. The water savings from the programs summarized in Table 7 above will contribute to maintaining a more stable water supply over time and reduce the need for regulatory actions. Such programs will continue to be evaluated and pursued if they are deemed beneficial for both enhancing water supply and maintaining Compact compliance. The effectiveness of these programs in meeting such goals will continue to be evaluated in subsequent five-year technical analyses.

Plan implementation has also included efforts to improve information sharing within and outside the Basin. Basin-wide plan annual meetings provide opportunities for Basin stakeholders, irrigation district representatives, NRDs and NeDNR to share information on Plan implementation activities and water supplies for the previous year and identify mutually beneficial opportunities to enhance Basin water supplies while maintaining Compact compliance. This information was made available to the public through publication of annual reports and materials to the Plan website and participation in education and outreach opportunities described further in the full report below. Additionally, the Drought Planning Exercise conducted in 2022 provided an opportunity for collaboration amongst various agencies and organizations in the Basin on improved drought planning and preparedness.

First Five-Year Technical Analysis for the Republican River Basin-Wide Plan

Results and Plan Progress Updates, 2019-2022

Findings Presented at the Basin-Wide Plan Annual Meeting, November 15, 2023

Report Submitted to the Nebraska Legislature, March 1, 2024

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

Table of Contents

Introduction

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Neb. Rev. Stat. § 46-755(5)(d) requires NeDNR and the Basin NRDs (Upper Republican NRD (URNRD), Middle Republican NRD (MRNRD), Lower Republican NRD (LRNRD), and Tri-Basin NRD (TBNRD)) to conduct a technical analysis within five years of Plan adoption, and every five years thereafter, of the actions taken in the river basin to determine progress towards meeting the Plan's objectives. This analysis must include (i) available supplies, current uses, and changes in long-term water availability; (ii) the effects of conservation practices and natural causes, including, but not limited to, drought; and (iii) the effects of the Plan in meeting the goal of sustaining a balance between water uses and water supplies. The analysis must also include a determination of whether changes to the Plan are needed to meet the goals and objectives. Any proposed modifications to the Plan must be presented at a public meeting, with a subsequent 30-day public comment period preceding a public hearing on the recommended modifications.

The first of these technical analyses (First Five-Year Technical Analysis) was conducted in 2023. Results of the First Five-Year Technical Analysis (Analysis) were presented at the basin-wide plan annual meeting jointly held by NeDNR and the NRDs on November 15, 2023. This report to the Nebraska Legislature includes Analysis results and a summary of the progress made towards meeting the Plan's goals and objectives during the Analysis Period (2019-2022).

Data approved by the Republican River Compact Administration (RRCA) were used to conduct the Analysis. These data are collected and reported following RRCA requirements and are used to determine compliance with the Republican River Compact (Compact). For further information on the RRCA and Compact, see the RRCA website.

Due to the nature of data collection and approval under the RRCA, and the statutory timeframe in which the Analysis was to be conducted, only four years of data (2019-2022) were available for evaluation. The subsequent Five-Year Technical Analysis, to be completed by the end of 2028, will include evaluation of a full 5 years of additional data (2023-2027). All subsequent Five-Year Technical Analyses under the Plan will also include evaluation of a full five year's additional data.

Analysis Results

Measurable Hydrologic Objectives (MHOs)

Evaluation of the five MHOs included in the Plan is intended to ensure reasonable progress is being made toward achieving Plan goals and objectives, as required under Neb. Rev. Stat. § 46-755 (4)(b). Three MHOs are to be evaluated annually (MHOs A, D, and E) and two are to be evaluated every five years, as part of each Five-Year Technical Analysis (MHOs B and C). Brief descriptions of each MHO and summaries of evaluation results are presented in the sections below.

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

MHO A is being achieved for UR/MR/LR NRDs if groundwater net depletions to streamflow are within allowable limits as specified in the *Monitoring & Studies Technical Memorandum for the URNRD, MRNRD, and LRNRD IMPs* (effective 9/27/2021). Net depletions must be less than allowable depletions over the averaging period, which is two, three, or five years, depending on conditions of the evaluation year, as specified in the RRCA Accounting Procedures and Reporting Requirements (Accounting Procedures).

Table 1. Summary of MHO A evaluation results for UR/MR/LRNRD during the Analysis Period.

Key to Possible Test Results	Year	URNRD	MRNRD	LRNRD
MHO is being achieved. NRD's actual depletions were within its allowable depletions. No further discussion is needed.	**2019**	●	●	●
MHO is not being achieved. NRD's actual depletions exceeded its allowable depletions. Discussion of next steps is required.	**2020**	●	●	●
	2021	●	●	●
	2022	●	●	●

Table 2. Annual and five-year average values used to evaluate MHO A.

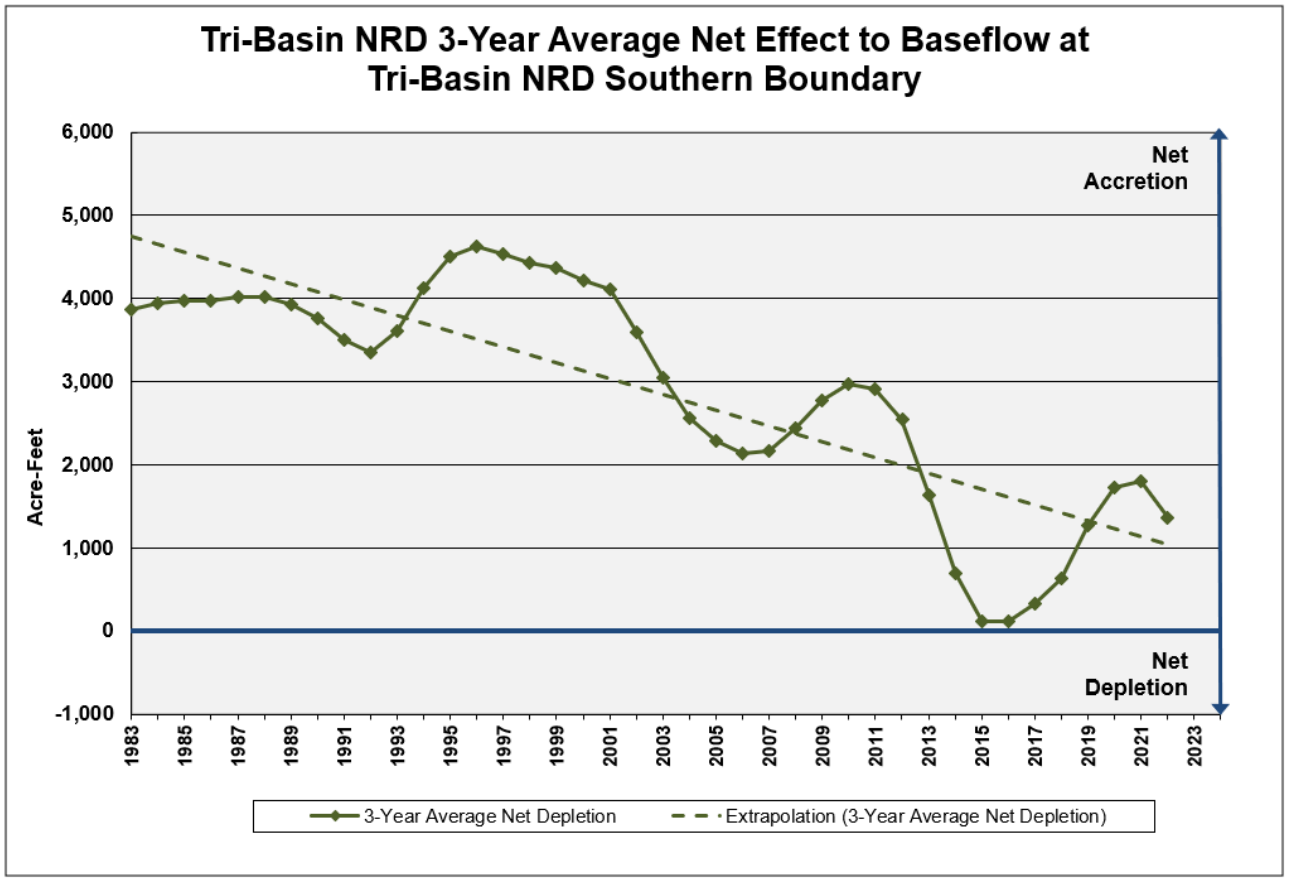
	Difference between allowable depletions and actual groundwater net depletions (acre-feet)		
Year	**LRNRD**	**MRNRD**	**URNRD**
2018	540	-1,919	2,922
2019	40,262	46,951	65,758
2020	14,844	28,487	26,335
2021	2,229	12,180	12,577
2022	-6,947	2,063	-7,059
5-year average (2018–2022)	**10,185**	**17,552**	**20,106**
5-year average positive?	**Yes**	**Yes**	**Yes**

For TBNRD to meet MHO A, the net effect to baseflow for TBNRD must be positive on a three-year rolling average basis. The net effect to baseflow is calculated by totaling the imported water credit (mound accretions) and the streamflow depletions at the southern boundary of TBNRD. The imported water credit consists of the accretion Nebraska receives credit for from groundwater 'imported' from the Platte Basin to the Republican Basin (irrigation canal losses and associated recharge). For further information on MHO A evaluation for each year, see the respective Integrated Management Plan (IMP) annual reports for the portion of TBNRD in the Basin.

Table 3. Summary of MHO A evaluation results for TBNRD during the Analysis Period.

Key to Possible Test Results	Year	Result
In compliance with IMP. On a three-year rolling average basis, depletions from groundwater pumping did not exceed accretions from the mound.	2019	
Caution. On a three-year rolling average basis, depletions from groundwater pumping exceeded accretions from the mound.	2020	
Insufficient management actions were taken in evaluation year to offset net depletions from previous year's assessment.	2021	
	2022	

Figure 1. Rolling three-year average net effect to baseflow at the southern boundary of TBNRD.



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.

Groundwater depletions to streamflow are defined as the difference between modelled streamflow with and without Nebraska groundwater pumping (calculated using the RRCA groundwater model), as defined in the Accounting Procedures. For TBNRD, groundwater depletions to streamflow are evaluated as the net impact of groundwater depletions to streamflow and the mound credit at the district's southern boundary for consistency with requirements of the IMP for the Portions of TBNRD in the Basin (effective 7/1/2012).

Groundwater depletion values (from approved RRCA accounting) for each of the Republican NRDs were statistically analyzed using the Mann-Kendall Trend Test. Depletion values were separately decorrelated for precipitation, undepleted baseflow, and virgin water supply, and these values were also analyzed using the Mann-Kendall Trend Test. This decorrelation was conducted to attempt to identify trends in depletions attributable solely to groundwater pumping and not variables such as weather, climate, and hydrologic conditions.

The analysis period was from 2008 – 2022 for URNRD, MRNRD, and LRNRD, and from 2013 – 2022 for TBNRD. The analysis described above is the screening phase for MHO B to be conducted as part of the Five-Year Technical Analysis. For MHO B to be met with no further action needed, all four Mann-Kendall Tests would need to indicate no-trend or a statistically significant decrease in depletions. For further details on the analysis methodology see the Methodology for MHO B Supplement to the Plan. As shown in Table 4 below, MHO B was met for all Basin NRDs. No statistically significant increasing trends in depletions were observed. Unmodified depletions are shown separately for each of the NRDs on Figures 2-5.

Figure 2. TBNRD unmodified groundwater net depletions to streamflow (2013 – 2022). TBNRD depletions are evaluated as the net impact of groundwater depletions to streamflow and the mound credit at the district's southern boundary for consistency with the TBNRD IMP. The negative depletion values represent a net accretion to streamflow due to the mound credit.

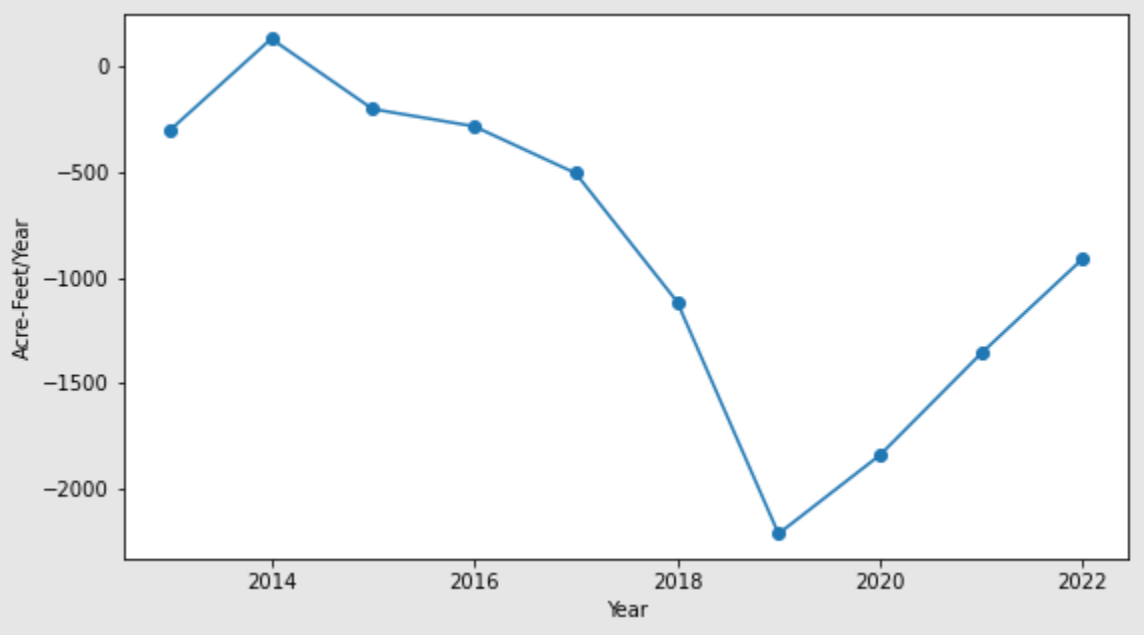


Figure 3. URNRD unmodified groundwater depletions to streamflow (2008 – 2022).

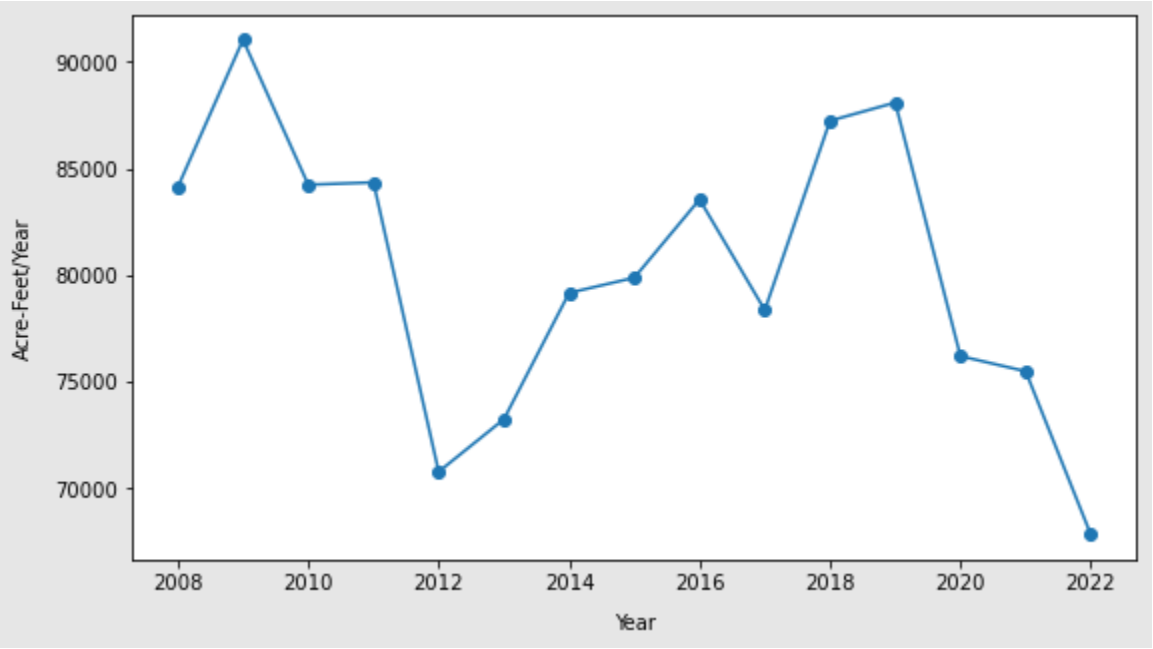


Figure 4. MRNRD unmodified groundwater depletions to streamflow (2008 – 2022).

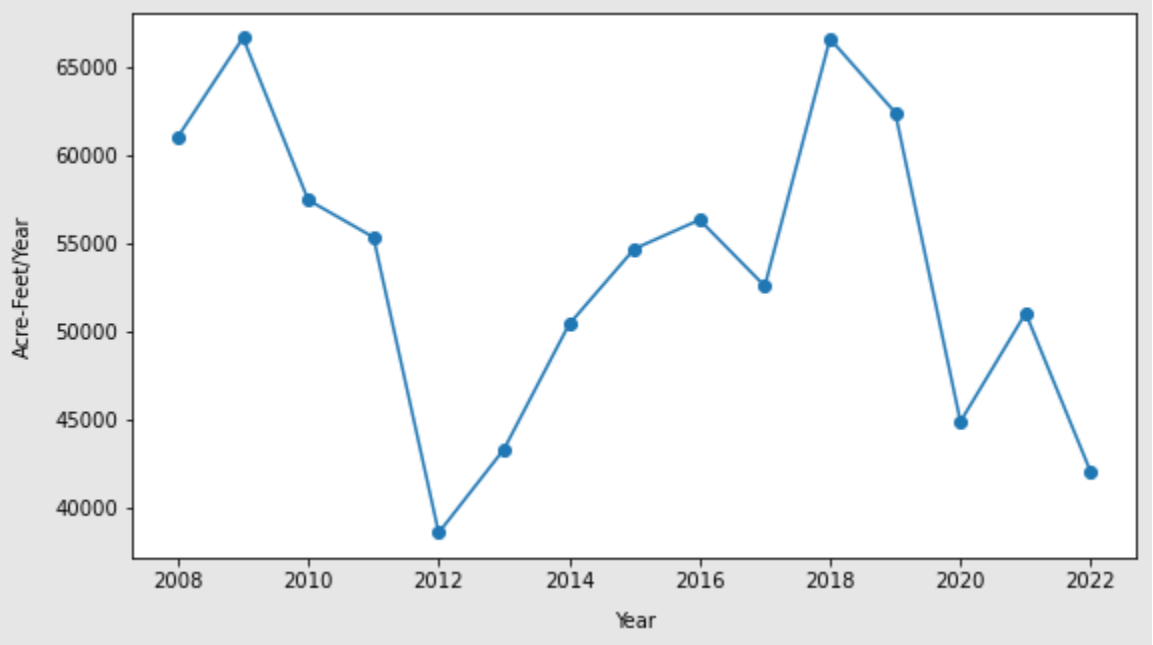


Figure 5. LRNRD unmodified groundwater depletions to streamflow (2008 – 2022).

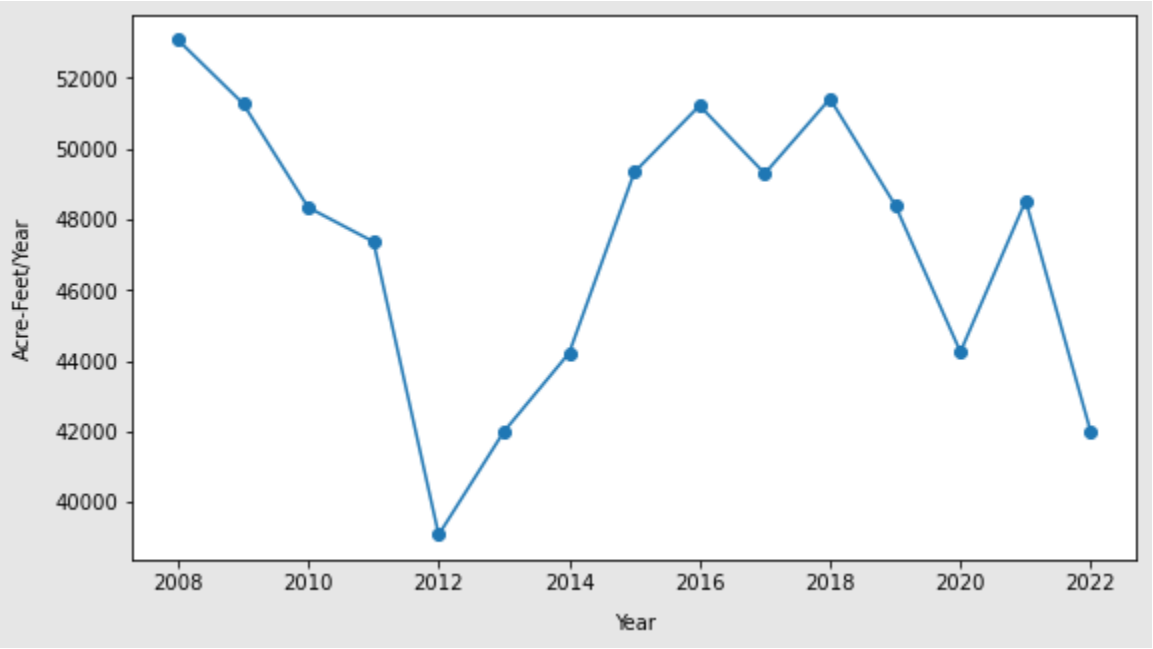


Table 4. Mann-Kendall Trend Test results for unmodified and decorrelated depletions and MHO B evaluation result. Depletions are from 2008 – 2022 for UR/MR/LRNRD and 2013 – 2022 for TBNRD.

Key to Possible MHO B Evaluation Results			
● In compliance with IMP. 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.			
Depletion Category	**Mann-Kendall Trend**	**Mann-Kendall Trend Significance**	**MHO B Evaluation Result**
URNRD			
Unmodified	No trend	0.198	●
Precipitation Decorrelated	No trend	0.373	●
Undepleted Baseflow Decorrelated	No trend	0.322	●
Virgin Water Supply Decorrelated	No trend	0.113	●
MRNRD			
Unmodified	No trend	0.235	●
Precipitation Decorrelated	No trend	1.0	●
Undepleted Baseflow Decorrelated	No trend	0.843	●
Virgin Water Supply Decorrelated	No trend	0.198	●
LRNRD			
Unmodified	No trend	0.428	●
Precipitation Decorrelated	No trend	0.488	●
Undepleted Baseflow Decorrelated	No trend	0.843	●
Virgin Water Supply Decorrelated	No trend	0.322	●
TBNRD			
Unmodified	Decreasing	0.032	●
Precipitation Decorrelated	Decreasing	0.012	●
Undepleted Baseflow Decorrelated	Decreasing	0.020	●
Virgin Water Supply Decorrelated	Decreasing	0.020	●

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.

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 (UNL) Conservation and Survey Division (CSD) datasets. The analysis period was from 2008 – 2022 for UR/MR/LRNRD, and from 2013 – 2022 for TBNRD for consistency with the MHO B assessment periods. Wells within one mile of two augmentation projects (Nebraska-Cooperative Republican Platte Enhancement Project (N-CORPE), Rock Creek) were excluded due to the possibility that localized effects from spring pumping for these projects might confound the intended analysis.

This analysis constitutes the first phase of screening for compliance with MHO C and was undertaken to identify those wells with a decreasing trend in average spring groundwater level. The second and third screening phases involve identifying any areas containing wells with groundwater levels declining at such a rate that there will not be enough groundwater available for all groundwater uses within the timeframe of the Plan and are to be conducted within approximately two years of the Analysis. If any such areas are identified, any necessary management actions to achieve MHO C will be implemented prior to the third annual meeting following presentation of the Analysis results. A preliminary effort toward completing phases two and three was conducted for this analysis by linearly projecting groundwater levels and comparing projected level with reported bottom of well elevation. Further investigation will be conducted by NeDNR and the Basin NRDs. For further information, see the Methodology for MHO C Supplement to the Plan.

Table 5. Mann-Kendall Trend Test results for average spring groundwater levels and count/percent of wells in each category from 2008-2022 for UR/MR/LRNRD, and from 2013-2022 for TBNRD.

Mann-Kendall Trend Result for Average Spring Groundwater Level	Count	Percent of Wells with Sufficient Data to Evaluate	Average Slope (feet/year)
URNRD			
Decreasing	198	70%	-0.617
Increasing	10	3%	0.320
No Trend	76	27%	-
Not Enough Data to Evaluate*	952	-	-
MRNRD			
Decreasing	30	24%	-0.340
Increasing	28	23%	0.222
No Trend	65	53%	-
Not Enough Data to Evaluate*	887	-	-
LRNRD			
Decreasing	19	5%	-0.236
Increasing	99	27%	0.426
No Trend	249	68%	-
Not Enough Data to Evaluate*	1226	-	-
TBNRD			
Decreasing	0	0%	-
Increasing	30	26%	0.574
No Trend	86	74%	-
Not Enough Data to Evaluate*	167	-	-

*These wells in the CSD/USGS databases had limited or no available 2008-2022 groundwater level data.

Figure 6. Map depicting all wells from the USGS and CSD databases located in the Basin and the identified trends in average spring groundwater levels for those wells with sufficient available data.

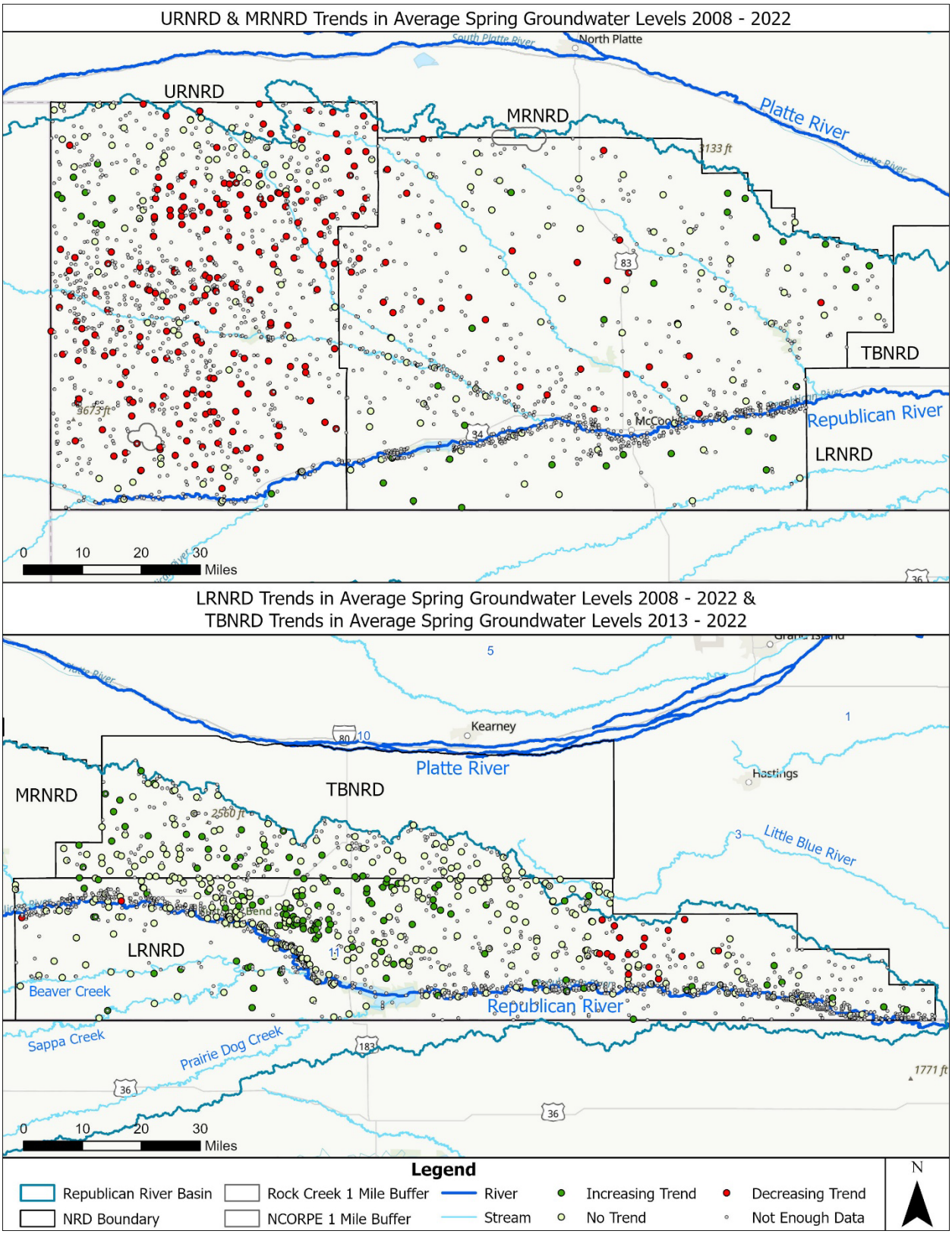


Figure 7. Map depicting wells within identified ranges of slope (for linear fits of average groundwater level). Slopes are only shown for wells with a statistically significant increasing or decreasing trend.

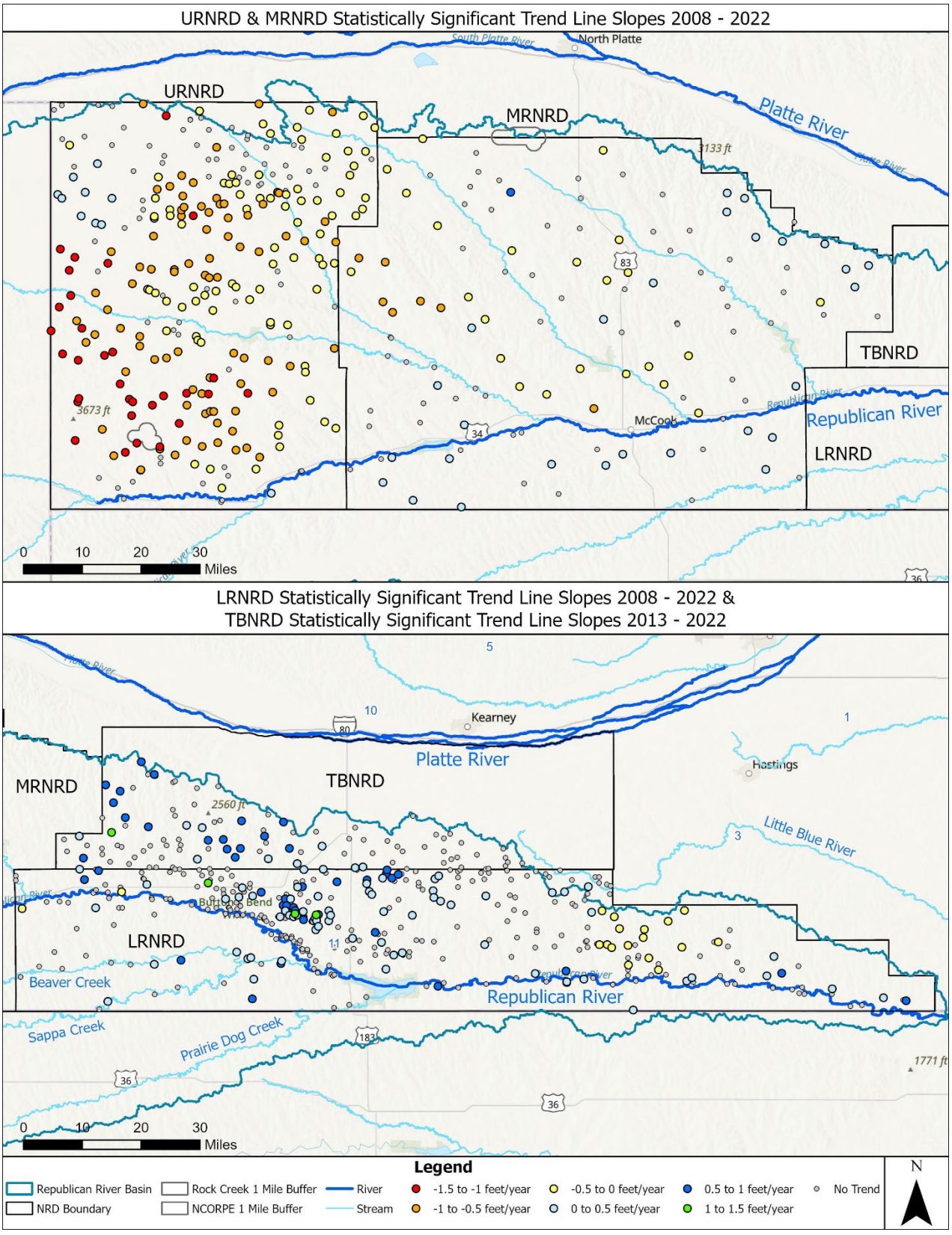
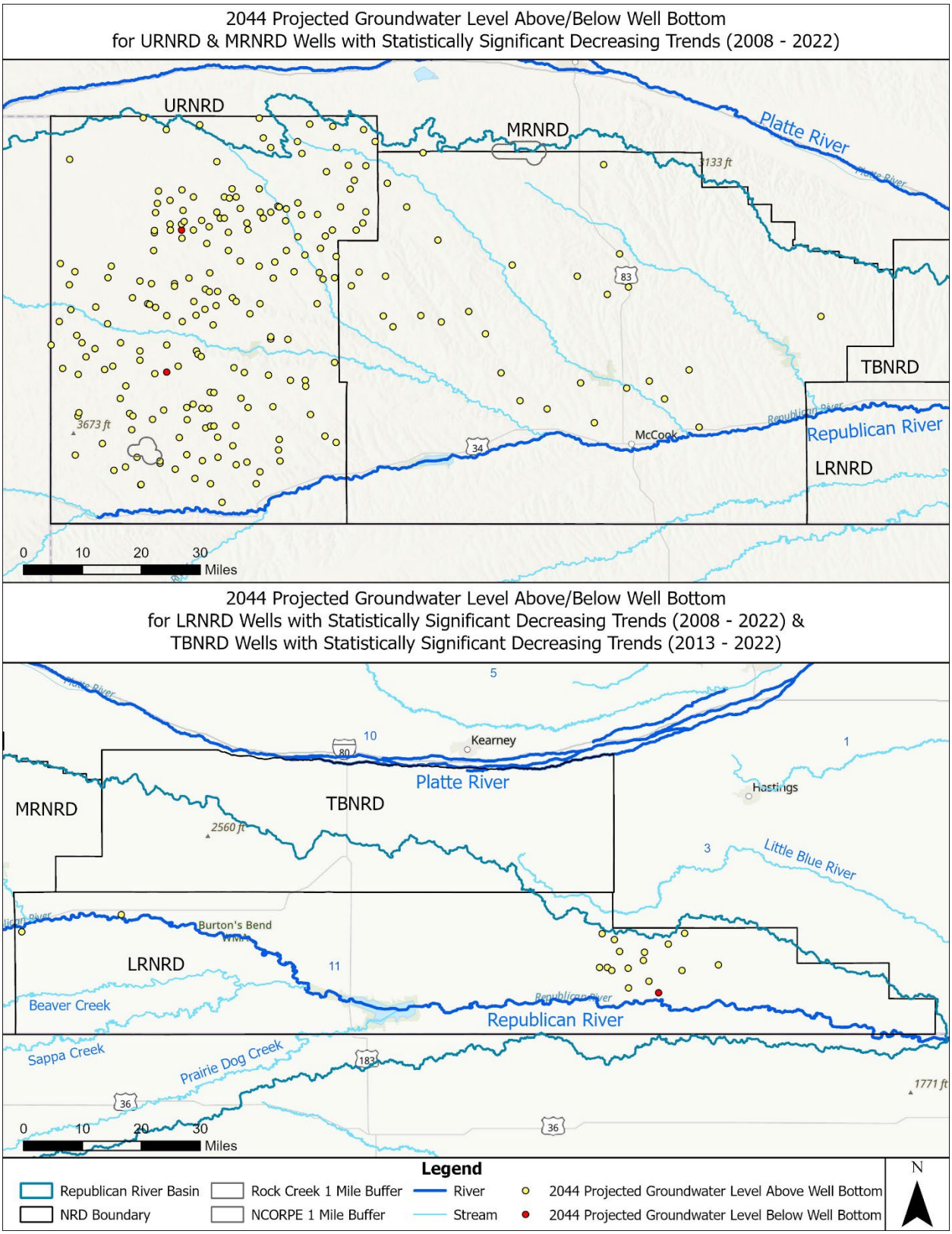


Figure 8. Map depicting which of the wells with a statistically significant decreasing trend have a 2044 projected groundwater elevation below the base of the well elevation.



As shown in Table 5 and Figure 6 above, of the 890 total wells in the Basin with sufficient data to evaluate using the Mann-Kendall Trend Test, the majority (72%) showed either no trend or an increasing trend in average groundwater level and 247 (28%) showed a decreasing trend. Spatial variability was observed in the distribution of wells with available data. See Figure 7 above for a general depiction of how the slopes of linear fits of average groundwater levels (for those wells with a statistically significant increasing or decreasing trend) varied throughout the Basin. Generally, slopes for most wells were between -1 to 1 foot/year, with clusters of wells with a larger negative slope in portions of URNRD and LRNRD. A few wells with larger increasing slopes were identified in LRNRD and TBNRD.

Among wells showing a statistically significant decreasing trend in average spring groundwater level, the average slope of the linear fit of those groundwater levels ranged from -0.236 feet/year for wells in LRNRD to -0.617 feet/year for wells in URNRD, as shown in Table 5. These decreasing trends were linearly projected to 2044 and the resulting estimated groundwater elevation (current reported elevation minus projected decrease) was compared to the reported base elevation of the wells. If the projected elevation is below the reported base elevation of the well by 2044 (end of the timeframe of the Plan), it suggests there may not be enough groundwater available in the general area surrounding the well for all groundwater uses within the timeframe of the Plan were the decreasing trend to continue as projected. Only four such wells out of the 248 with a statistically significant decreasing trend were identified. These wells are depicted in Figure 8 above. 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.

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

MHO D assesses whether groundwater pumping within the Rapid Response Area of URNRD, MRNRD, or LRNRD was curtailed to ensure Compact compliance during the previous year. There is no Rapid Response Area designated within TBNRD. These areas are designated in the IMPs and rules and regulations for the NRDs (linked in Supplemental Information section). The 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 projects undertaken throughout the Analysis Period can be found in the Progress Made Under the Plan section of this report.

Table 6. Summary of MHO D evaluation results for UR/MR/LRNRD during the Analysis Period.

Key to Possible Test Results	Year	URNRD	MRNRD	LRNRD
MHO is being achieved. NRD did not curtail groundwater pumping within the Rapid Response Area to ensure Compact compliance. No further discussion needed.	**2019**	●	●	●
	2020	●	●	●
MHO is not being achieved. NRD curtailed groundwater pumping within the Rapid Response Area to ensure Compact compliance. Discussion of next steps is required.	**2021**	●	●	●
	2022	●	●	●

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. NeDNR and the Basin NRDs have undertaken many projects that reduce the potential future need for surface water administration for

Compact compliance. Examples of projects undertaken throughout the Analysis Period can be found in the Progress Made Under the Plan section of this report.

Table 7. Summary of MHO E evaluation results for UR/MR/LRNRD during the Analysis Period.

Key to Possible Test Results	Year	Result
MHO is being achieved. NeDNR did not administer surface water to ensure Compact compliance, except as required under the FSS. No further discussion needed.	**2019**	
	2020	
MHO is not being achieved. NeDNR administered surface water to ensure Compact compliance. Discussion of next steps is required.	**2021**	
	2022	

Action Item 2.5.2: Analyzing Lag Time of Streamflow Depletion from Groundwater Pumping

To fulfill Action Item 2.5.2 of the Plan, the RRCA groundwater model was used to analyze future impacts of past groundwater pumping (residual effects) in the Basin. This analysis was intended to answer the question, "if groundwater pumping in the Basin were to stop completely, how long would it take streamflow to recover (i.e., return to a condition with no pumping-related stream depletions)?"

For this analysis, the RRCA-approved groundwater models from the RRCA 5-run procedure (used to determine depletions by individual states in the Compact) for determining Nebraska impacts to baseflow were used. The initial conditions consisted of the final calculated groundwater levels from RRCA-approved 5-run procedure model runs through 2021. One model from the 5-run procedure used in this analysis has no Nebraska groundwater pumping (no NE pumping) and the second contains groundwater pumping from all wells in the model area (historical pumping). The no NE pumping run represents a theoretical baseline condition in which there was no historical groundwater pumping. These models both begin their transient period (in which change in conditions over time is simulated) in 1918 and run through the year 2021.

In this analysis, reductions in baseflow impacts resulting from stopping Nebraska groundwater pumping are calculated as the difference in baseflow between the historical pumping and no NE pumping runs when they are projected 200 years into the future, to the year 2221 In the future simulation portion of the historical pumping run, Nebraska groundwater pumping stops (is set to 0), while Nebraska pumping in the no NE pumping run remains at zero. Therefore, annual baseflow impacts in the future simulation comparisons consisted of the lagged impacts from the historical pumping up to 2022.

Due to the sensitivity of the baseflow impacts to annual weather/hydrology, the pairs of future simulations were modeled under four future climatic conditions. Annual model input data for each of the 200 years in the simulated period consisted of repeated historical model input data for the representative year/years selected for each climate condition. These conditions included low precipitation (represented by 2012 input data), average precipitation (2014), high precipitation (2018), and a cyclic/variable condition (2012-2021). All groundwater model input data with the exception of pumping and associated recharge was included in the historical run.

For example, to model the baseflow impacts with the low precipitation climate conditions, 2012 input data for the historical run were prepared by removing representations of Nebraska pumping and associated recharge and repeated 200 times to represent 200 future years without pumping. Unmodified

2012 input data for the no NE pumping run was also repeated 200 times to represent future years. Then the historical model run and the no NE pumping model run were extended 200 years from their respective starting groundwater levels at the end of the 2021 approved RRCA groundwater model runs using the respective repeated input data. The historical run baseflow was subtracted from the no NE pumping run baseflow for the 200 year projection period, and the result is the calculated depletions under a 200-year low precipitation climate condition.

Calculated depletions for each of the scenarios are presented in Table 8 and Figure 9 below.

Table 8. Summary data from the four lag-time simulation scenarios.

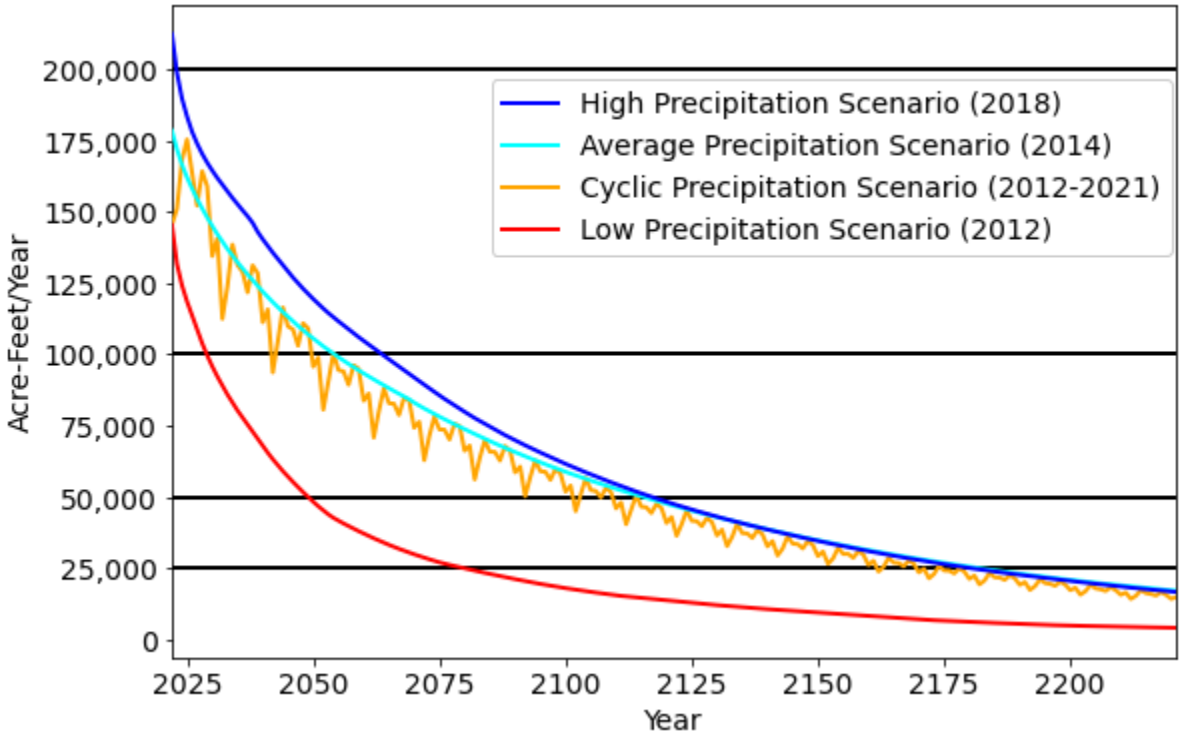
	Low Precipitation Scenario (2012)	Average Precipitation Scenario (2014)	High Precipitation Scenario (2018)	Cyclic Precipitation Scenario (2012-2021)
Annual depletions (acre-feet) at end of Plan timeframe (2044)	58,963	114,826	131,240	116,442
Annual depletions (acre-feet) after 200 years (2221)	3,993	16,981	16,581	14,789
Years to 100,000 acre-feet annual depletions (50% reduction)*	7	32	41	32
Years to 50,000 acre-feet annual depletions (75% reduction)*	27	93	94	70
Years to 25,000 acre-feet annual depletions (87.5% reduction)*	57	159	157	140
Cumulative Depletions (acre-feet)	4,899,595	11,836,129	12,783,201	11,026,611

***Note: Nebraska's annual groundwater depletions to streamflow between 2008 and 2021 averaged approximately 200,000 acre-feet. The annual depletions milestones in Table 8 above represent 50%, 75%, and 87.5% reductions from this average value.

As shown in Table 8 above and Figure 9 below, annual depletions generally decreased each year under all four scenarios. The low precipitation scenario was an outlier compared to the others for both cumulative depletions and the rate at which annual depletions decreased. Annual depletions decreased most rapidly under this scenario due to rapidly diminishing modeled baseflow. In other words, under the extreme prolonged drought conditions represented by the low precipitation scenario less baseflow was available to deplete resulting in lower annual and cumulative depletions than under the other scenarios.

This analysis indicates it would take more than 200 years for Basin streamflow to return to a condition with no pumping-related stream depletions. By the end of the 200-year simulation period, annual Nebraska depletions ranged between 3,993 and 16,981 acre-feet(AF)/year under the four scenarios as compared to the current average annual depletion of 200,000 AF/year. As shown in Figure 9, annual depletions decreased most rapidly in the earlier years of all scenarios as shown in the steeper slope of the graph between simulation years 2025 and 2075 versus the more gradual slope after 2075. By the final year included in the Plan implementation timeframe (2044), annual depletions ranged from 58,963 to 131,240 AF/year under the four scenarios.

Figure 9. Graph showing simulated lagged groundwater depletions to streamflow (acre-feet) per year (2022-2221) for the four simulation scenarios.



Analysis of Available Supplies, Current Uses, & Changes in Long-Term Water Availability

Available Supplies

The water supply available for beneficial use in Nebraska is limited to the state's allocation under the Compact. The allocation is the sum of fixed percentages of the computed water supply in each Republican River subbasin, as detailed in the FSS and Accounting Procedures. The computed water supply generally includes an estimate of all surface water and groundwater consumptive use (resulting in streamflow depletions) added to measured streamflow. Groundwater consumptive use is estimated using the approved RRCA groundwater model. Nebraska receives a credit to offset some consumptive use in proportion to the RRCA model-estimated increase in groundwater levels due to seepage into the Basin from the Upper Platte Basin (imported water/mound credit). Generally, calculated net consumptive use (column 2 – column 3 in Table 9 below) for Nebraska must remain at or below the allocation on average over five years (under normal conditions) or two years (under Water-Short Year (WSY) administration). A WSY is declared when the projected or actual water supply for irrigation at Harlan County Lake (HCL) is less than 119,000 AF. Table 9 below includes summary data for the state's allocation and consumptive use over the previous five-year period.

Table 9. Approved summary RRCA accounting data for Nebraska from 2018-2022 (all values in acre-feet).

Year	Allocation (Col 1)	Computed Beneficial Consumptive Use (Col 2)	Imported Water Supply Credit and Nebraska Resolution Water Supply Credit (Col 3)	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit and NERWS Credit Col 1 – (Col 2- Col 3)
2018	241,680	266,080	25,943	1,543
2019	389,300	262,870	26,541	152,971
2020	303,070	252,400	18,995	69,665
2021	258,180	252,650	21,456	26,986
2022	221,860	249,960	16,157	-11,943
Average 2018-2022	282,820	256,790	21,820	47,840

Current Uses

Generally, major beneficial consumptive uses of water in the Basin include groundwater pumping for irrigation and municipal/industrial use, use of surface water by irrigation districts/irrigators, and reservoir evaporation. In 2022, 221,036 of the 1,953,483 irrigated acres within the RRCA Groundwater Model area in Nebraska (11.3%) were surface water irrigated or commingled, with the remainder being groundwater-only irrigated. The computed uses of the water supplies for Compact Accounting are referred to as "Computed Beneficial Consumptive Use" (CBCU). Table 10 below shows several categories of CBCU for Nebraska from 2018 – 2022. The RRCA groundwater model considers the effects of pumping since early well development beginning in 1918, therefore, the groundwater consumptive use of streamflow in each year is impacted by pumping in that year and all previous years.

Table 10. Approved CBCU RRCA accounting data for Nebraska from 2018-2022 (all values in acre-feet).

Year	Surface Water CBCU (SW CBCU) – Irrigation & Canal Losses	SW CBCU – Non-Federal Reservoir Evaporation	SW CBCU – Federal Reservoir Evaporation	SW CBCU – Total	Total Groundwater CBCU
2018	29,948	1,181	12,603	43,733	222,338
2019	29,727	1,003	15,789	46,519	216,337
2020	39,299	2,695	31,371	73,365	179,049
2021	39,825	1,940	19,606	61,370	191,285
2022	46,522	3,518	35,700	85,740	164,197

Water use for irrigation, a major component of the current uses summarized in Table 10, is distributed under the groundwater allocation and surface water allotment systems in the Basin. These systems are summarized in the sections below. An evaluation of these systems was conducted for the Analysis to fulfill Action Items 2.7.1 and 2.7.2. Results of this evaluation are also presented below.

Surface Water Allotment System

Active irrigation districts within the Basin during the Analysis Period included Pioneer Irrigation District (Pioneer), Hitchcock & Red Willow Irrigation District (H&RW), Nebraska Bostwick Irrigation District (NBID), Frenchman Valley Irrigation District (FVID), and Frenchman Cambridge Irrigation District (FCID). These irrigation districts use both flowing water and water stored within the US Bureau of Reclamation's (USBR's) five reservoirs in Nebraska and hold water rights that are administered by NeDNR. There are

also individual surface water permit holders. Tables 11 and 12 below show permitted acres by irrigation district and by use-type for other, privately held appropriations.

Table 11. Permitted surface water irrigation acres in the Basin by irrigation district. From the NeDNR surface water permitting database (as of July 26, 2023).

Irrigation District	Acres Permitted for Irrigation
FCID	45,669
NBID	22,455
H&RW	11,857
FVID	9,323
Pioneer	1,900
Riverside*	540
Total	91,744

*Riverside Irrigation Company is no longer active; MRNRD purchased the associated water rights in 2011 and will make the associated water available if needed for maintaining Compact compliance.

Table 12. Surface water permits and associated acres in the Basin for all users other than irrigation districts. From the NeDNR surface water permitting database (as of July 26, 2023).

Use	Number of Permits	Acres Permitted for Irrigation
Irrigation	241	17,205
Power	1	-
Irrigation from Reservoir Only	11	678
Storage	188	-
Total	441	17,883

Irrigation districts that have agreements with the USBR are allocated a certain portion of the storage capacity of the five USBR reservoirs in Nebraska. Near the start of the year, the irrigation districts notify their customers of the amount of water available to them for irrigation and the rate they will be charged per inch for delivery. This determination is based on the amount of water available for irrigation in basin reservoirs. The fee per inch is in addition to the amount surface water irrigators pay for each acre on an annual basis regardless of delivery amount.

Surface water is administered as necessary during Compact Call Years (CCYs) as described in the 5th generation IMPs for LR/MR/URNRD (effective 9/27/2021; linked in Supplemental Information section), and the IMP for the portions of TBNRD in the Basin. A CCY is a year in which the forecast volume (e.g., in 2021 Forecast of Allowable Depletions) indicates compliance activities such as augmentation, water rights administration, and other actions may be necessary to ensure Compact compliance. This water administration might include issuing closing notices on necessary natural flow and storage permits in the Basin such that augmentation water can be delivered to the appropriate diversion point.

As described in the 5th generation IMPs for LR/MR/URNRD, and the IMP for the portions of TBNRD in the Basin, all surface water diversions must be metered at the point of diversion from the stream. For surface water canals that are not part of USBR projects, farm turnouts must install and maintain NeDNR-approved measuring devices. These measurement devices allow monitoring to ensure the rate of diversion and annual diverted amount do not exceed amounts allowed by applicable permit/statute, and in turn, ensure Nebraska can continue to maintain compliance with the Compact. There is also a moratorium on issuing new surface water permits in the Republican NRDs. Furthermore, NeDNR will regulate and administer surface water in the basin as necessary to ensure Compact compliance.

Groundwater Allocation System
All NRDs in the Basin have moratoriums on new groundwater well development and require existing wells to be metered. LRNRD, MRNRD, and URNRD have district-wide allocations. Due to the imported water (mound) credit offsetting groundwater depletions in their district, TBNRD only has an allocation in one region of the district with a sufficient decline in groundwater levels to trigger such a requirement (Phase 3 Groundwater Quantity Management Area - Union Township). District-wide allocations were 65 inches/acre/5-years, 60 inches/acre/5-years, and 45 inches/acre/5- years for URNRD, MRNRD, and LRNRD during the Analysis Period, respectively. TBNRD had a 27 inch/acre/3-years allocation for Union Township. For further information on the allocation amounts and rules for all four Basin NRDs, see Appendix H of the Plan, and the 2019, 2020, 2021, and 2022 Basin-Wide Plan Annual Reports.

Analysis of Surface Water Allotment and Groundwater Allocation Systems Impact (Action Item 2.7.1)
Surface water and groundwater users maximize their beneficial use of the available water supply (state allocation) under the current allotment/allocation systems. Controls are in place to curtail groundwater pumping and surface water diversions during CCYs. Surface water and groundwater users are both required to meter their use and remain within allowable amounts of total use to ensure Compact compliance is maintained.

The groundwater allocation system will ultimately result in a more stable and predictable impact of groundwater use on surface water flow. This stability will benefit surface water users, who face more inherent uncertainty in their water supply. Additional controls may be implemented if substantial declines in groundwater levels are identified through evaluation of MHO C. Such controls would also benefit surface water users by diminishing the impact of declining groundwater levels on the available surface water supply.

A CCY could result in surface water rights administration (e.g., closing junior water rights) by NeDNR if necessary. FCID and NBID have agreed to work with NeDNR and Basin NRDs to maintain Compact compliance per terms of agreements with NeDNR to provide Water Resources Cash Fund (WRCF) funding to these districts. These WRCF-funded projects will result in improved canal efficiency, as further described in the Progress Under the Plan section of this report below.

Recommended Changes to Surface Water Allotment and Groundwater Allocation Systems (Action Item 2.7.2)
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.

Changes in Long-Term Water Availability

There were no definitive trends in long-term water availability in the Basin identified from results of the MHO analyses described above. Relevant further investigation will be conducted through subsequent phases of the MHO C analysis. The projects implemented under the Plan described in this report (particularly in the Progress Under the Plan section below) to reduce consumptive use, enhance storage capacity, and increase groundwater recharge in the Basin will improve long-term water availability. Relevant MHO analysis results are further discussed below.

As shown in Figure 1, there has been a downward trend in net effect to baseflow at the southern boundary of TBNRD (largely due to a downward trend in mound accretions). This decrease in the net accretion may eventually necessitate implementation of additional management actions in TBNRD and indicates the overall available water supply in TBNRD may decrease to some degree.

MHOs B and C were designed to evaluate changes in long-term water availability throughout the Basin, particularly the effect of groundwater pumping on streamflow and groundwater supply. MHO B analysis

results indicate there has not been a statistically significant increase in groundwater depletions to streamflow for any of the Basin NRDs. MHO C analysis results indicate groundwater levels may be increasing in some areas of the Basin and decreasing in others since the beginning of the analysis period in 2008. Declining average spring groundwater levels were observed for more wells in the western section of the Basin, and stable or increasing groundwater levels were observed more in the eastern section of the Basin. The central section of the Basin had the least clear overall trend with a roughly equal number of wells with increasing and decreasing trends, and the fewest available wells with sufficient data to evaluate such trends. The magnitude and spatial variability of the observed trends will be further assessed in subsequent phases of the MHO C analysis. Overall, these two MHO analyses did not reveal a definitive trend in long-term water availability throughout the Basin.

Over the Analysis Period, Nebraska's allocation fluctuated without any clear overall trend, consistent with the findings for MHO B and C as described above. These fluctuations may be partially explained by natural causes, as further described in the section below.

Analysis of Effects of Conservation Practices and Natural Causes

Conservation Practices

A literature review was conducted by NeDNR to fulfill Action Item 2.5.1 of the Plan. The purpose of this review was to compile information regarding impacts of conservation practices on the water balance and water quality in the Basin. The primary findings of the report include identifying a tradeoff between decreased runoff in the short-term and increased groundwater storage and baseflow contributions to streamflow in the long-term associated with many of the conservation practices. While these tradeoffs were identified, it was beyond the scope of the review to assess or quantify the potential magnitudes of such trade-offs or how they might differ throughout the Basin. The results of this literature review were combined in a report to serve as a reference for NRDs, Basin water users, and other interested parties.

Natural Causes

As described in section 1.2 (Drought History and Economic Impact) of the *Report on the Republican River Basin Drought Planning Exercise* (conducted between August 2020 and January 2023; see further description in Action Items 2.8.1/2 section below), the Basin historically cycles between periods of above and below average precipitation. This cyclic precipitation appears to have had an impact on Compact Accounting during the Analysis Period, although the full extent of this impact cannot be conclusively determined as there are many other contributory factors and complex relationships between these factors.

As shown in Table 13 below, average precipitation in the Basin was greatest in 2019, with more typical precipitation in 2021 and below-average precipitation in 2020 and 2022. The above average precipitation in 2019 was associated with the greatest annual streamflow at the Hardy Gage and highest allocation in the Analysis Period, and an increase in HCL storage. The below average precipitation in 2022 was associated with the least annual streamflow at the Hardy Gage and lowest allocation in the Analysis Period, and a decrease in HCL storage. However, this decrease in streamflow at the Hardy Gage in 2022 may be partially attributable to the increased efficiency in diversions into the Courtland and Superior canals between HCL and the Hardy gage as a result of the NBID automation project (see Improved Canal System Efficiency section in Progress Under the Plan below). This improved efficiency of the canal system will generate savings that will allow for increased storage in HCL, decreased diversions from the Republican River, and increased groundwater recharge.

Table 13. Selected Compact Accounting Data from the Analysis Period.

Year	Average Annual Precipitation* (inches)	Nebraska Allocation (acre-feet)	Annual Streamflow at Hardy Gage (acre-feet)	Annual Change in Storage for HCL (acre-feet)
2019	29.6	389,300	626,376	74,701
2020	16.9	303,070	251,239	-50,098
2021	22.9	258,180	142,153	754
2022	15.1	221,860	69,603	-54,915

*Average precipitation is for the climate stations in Nebraska as reported for Compact Accounting. All data are from approved Compact Accounting and are available on the RRCA website.

Analysis of Effects of Plan in Meeting Goal of Sustaining a Balance Between Water Uses and Water Supplies

Overall, Plan implementation has been successful in achieving the goals of maintaining Compact compliance while maximizing Nebraska's beneficial use of the available water supply and taking steps to ensure the stability of that supply over the long term. As shown in Table 9, CBCU has been near but below Nebraska's allocation over the 5-year averaging period typically used for determining Compact compliance (under normal conditions). The water savings from the programs summarized in the Conservation Practices section above will contribute to maintaining a more stable water supply over time and reduce the need for regulatory actions.

Plan implementation has also included efforts to improve information sharing within and outside the Basin. Plan implementation efforts are further described in the section below.

Progress Made Under the Plan

Goal 1: Maintain Compliance with Compact and applicable state laws*
During the Analysis Period this goal was met. Nebraska remained in compliance with the Compact through Plan implementation in accordance with state laws.

*Note: Descriptions of goals/objectives/action items in this section are abbreviated; see Plan for complete language.

Objective 1.1: Coordinate management actions with Compact compliance efforts

Action Item 1.1.1: Review actions for cost-efficiency, practicability, impact on compliance
During the Analysis Period all Basin-wide management actions were reviewed in accordance with Action Item 1.1.1. The Republican Basin NRDs and NeDNR do not expect any of these management actions to negatively impact efforts to achieve Compact compliance in the most efficient and cost-effective way under state law.

Action Item 1.1.2: Implement appropriate offsets for any actions exceeding allocation
For this action item, the Plan defines offsets as actions that either reduce water use or increase water supply for the purpose of staying within Nebraska's Compact allocation. No offsets were required to remain in compliance with the Compact as the result of any Plan action during the Analysis Period. If offsets were to be required, procedures outlined in the *Monitoring & Studies Technical Memorandum for the URNRD, MRNRD, and LRNRD IMPs* and the IMP for the Republican Basin portions of TBNRD would be followed. Through implementation of these procedures, NeDNR and the Republican Basin NRDs will take any necessary offsetting actions to ensure that Nebraska remains in compliance with the Compact.

Objective 1.2: Evaluate effects of management actions for Compact compliance on water supplies

Action Item 1.2.1: Qualitatively evaluate net effect of any actions

A qualitative evaluation of the net effect on water supplies of all management actions taken by NeDNR or an NRD for Compact compliance was presented at the Plan annual meetings and summarized in the Plan annual reports. No regulatory actions were taken to maintain Compact compliance during the Analysis Period. Other types of management actions and their net effects are described throughout this report. Generally, these actions are anticipated to have a positive effect on water supplies by reducing consumptive use of water.

Objective 1.3: Assess progress toward meeting goals/objectives, share results with public/legislature

Action Items 1.3.1/2: Conduct technical analysis within five years, evaluate progress on meeting MHOs

Both action items were completed. A technical analysis of the progress made towards meeting the goals and objectives of the Plan was conducted within five years of Plan implementation and will be conducted every five years thereafter. Each MHO was evaluated within the timeframe specified in the Plan. Results of these MHO analyses are summarized in the Analysis Results section of this report and in the Plan annual reports.

Action Items 1.3.3/1.3.4: Share Analysis results with public, submit report to legislature

Both action items were completed. Results of the Analysis and any recommend Plan modifications (none) were presented to the public at the basin-wide plan annual meeting on November 15, 2023. This report to the legislature documenting results of the Analysis and progress made under the plan was submitted to the legislature on March 1, 2024.

Objective 2.1: Understand feasibility and potential impacts of plan actions, establish project procedure

Action Items 2.1.1/2/3: Evaluate proposed projects, summarize in annual reports, implement projects

All proposed projects during the Analysis Period were evaluated for hydrologic and economic feasibility and potential economic and environmental impacts in accordance with this objective and the respective action items. These projects were developed in compliance with local, state, and federal permitting requirements. For details on specific projects see the 2019-2022 Plan annual reports.

Objective 2.2: Improve efficiency of use, availability/reliability of water supplies for current irrigators

Action Items 2.2.1/2: Work with irrigators to improve efficiency of delivery/use system, participate in projects to improve reliability/availability/sustainability of water supply

During the Analysis Period, NeDNR and the Basin NRDs worked with local, state, and federal entities to fund projects that improved the efficiency of water use or improved water availability and reliability for irrigators. These projects achieved the objectives through voluntary reduction of irrigated acres, improved irrigation efficiency, improved efficiency of the Basin's canal system, on-going and new conjunctive management projects, and other measures as further described below.

Voluntary Irrigation Reduction Programs

During the Analysis Period all four Basin NRDs participated in the Conservation Reserve Enhancement Program (CREP), a program administered by the United States Department of Agriculture (USDA)'s Farm Service Agency (FSA), which provides federal funding for the temporary removal of environmentally sensitive land from agricultural production. As per NRD rules, irrigation water cannot be used on certified acres enrolled in this program. Acres enrolled in CREP and estimated water savings are summarized in Table 14 below. URNRD and MRNRD also worked with landowners on a voluntary basis to permanently

decertify irrigated acres in areas of high stream depletion, as shown in Table 16. Decertified acres were converted to pastureland or dryland crop production. These decertification projects were partially funded by the WRCF and will result in an estimated total 46,218 acre-feet of water savings throughout the timeframe for Plan implementation.

Table 14. Acres enrolled in CREP during the Analysis Period by NRD, and estimated water savings from irrigation cessation on these lands.

Year	URNRD Acres Enrolled in CREP	MRNRD Acres Enrolled in CREP	LRNRD Acres Enrolled in CREP	TBNRD Acres Enrolled in CREP	Total Estimated Water Savings (acre-feet)
2019	10,499	12,310	6,644	2,329	16,787
2020	10,589	16,559	8,382	2,201	36,742
2021	8,970	14,842	6,724	1,910	28,720
2022	8,630	14,555	6,975	1,742	39,336

TBNRD's Water Conservation Incentive Program (WCIP) reimbursed irrigators for reduced groundwater use through enrollment in a voluntary five-year allocation program. It also included a commingled option which encouraged irrigators to prioritize the use of surface water on their commingled acres. This had the dual benefit of reducing groundwater pumping and increasing groundwater recharge. This program resulted in an estimated 550 acre-feet of water savings during the Analysis Period, as shown in Table 15. NeDNR reimburses TBNRD for 60% of this project's total cost through the WRCF.

Table 15. Acres enrolled in TBNRD's WCIP program and estimated water savings during the Analysis Period.

Year	Total Acres Enrolled	Estimated Water Savings (acre-feet/year)
2019	1,450	121
2020	1,445	121
2021	1,579	132
2022	2,114	176
	Total	550

Table 16. Total acres decertified by each NRD during the Analysis Period and estimated water savings from retirement year to final year of the Plan (2044).

NRD	Decertified Acres	Local Funds	State Funds[1]	Estimated Water Savings (acre-feet)
URNRD	2,639	$3,045,995.95	$4,546,894.05	40,572
MRNRD	408.3	$468,425.67	$703,538.51	5,646

1. State funding sourced from the WRCF.

Improved Irrigation Efficiency

NeDNR signed contracts with URNRD and MRNRD between 2019 and 2022 to provide matching funding for projects to deploy near real-time telemetry equipment on irrigation flow meters and install telemetry-equipped weather stations and soil moisture probes in these districts. These projects resulted in water savings by facilitating irrigation scheduling decision-making to improve efficiency and help irrigators ensure they stay within their allocations. Full implementation of these projects is estimated to result in a combined 39,529 acre-feet of water savings per year per the estimated values provided in URNRD's

associated Water Sustainability Fund (WSF) grant applications, and MRNRD's WaterSMART grant applications. Funding for these projects and estimated water savings are summarized in Table 17. In 2023, NeDNR signed contracts with URNRD, LRNRD, and TBNRD for similar telemetry projects. The impact of these projects will be assessed during the next Five-Year Technical Analysis.

LRNRD participated in the USDA Natural Resources Conservation Service (NRCS) Regional Conservation Partnership Program (RCPP) during the Analysis Period. Under this program, LRNRD provided cost-share for soil moisture sensors, end gun removal, and the conversion of gravity irrigation to subsurface drip. The five-year program ended in 2021.

Table 17. Summary of funding used for improved irrigation efficiency projects during the Analysis Period and estimated annual water savings anticipated to result from full implementation of these projects.

NRD	Local Funds	State Funds	Federal (USBR) Funds	Estimated Water Savings
URNRD	$390,384	$585,576[3]	-	29,133 AF/year[1]
MRNRD	$2,037,049	$2,050,000[4]	$2,800,000	10,396 AF/year[2]

1. Combined values from URNRD's WSF grant applications: Remote Monitoring (application number 5221), Soil Moisture Probe Program (application number 5222) and additional Soil Moisture Probes (application number 5301).
2. Combined values from MRNRD's Phase 1 and 2 Remote Meter and Irrigation Conservation Project WaterSMART grant applications.
3. Funding sourced from WSF.
4. $250,000 from WSF and $1,800,000 from WRCF.

Improved Canal System Efficiency

NeDNR signed contracts with FCID and NBID to share costs of multiple projects aimed at enhancing the delivery of surface water through canals in the Basin, as shown in Table 18. LRNRD also provided funding for a FCID project.

These projects largely targeted the reduction of "operational spills", a term describing the unintentional release of more water through a canal than was called for. Outdated manual control gates were upgraded to accurate, remotely operated models. Remotely operated flow measurement instruments were also upgraded. The result was an improvement in the ability of canal system operators in multiple areas of the Basin to have accurate control over canal flowrates from a remote location at any time of day.

The irrigation districts agreed to make the water savings from these efficiency improvements available for Compact compliance when needed. This arrangement allows water that would have otherwise been wasted to be put to beneficial use.

Table 18. Summary of funding for canal system efficiency improvement projects during Analysis Period.

Irrigation District/NRD	Local Funds	State Funds	USBR Funds	Estimated Water Savings
FCID	$838,874	$2,528,643[3]	$1,500,000	3,673 AF/year[1]
NBID	$11,075	$2,548,950[4]	$2,075,000	4,406 AF/year[2]

1. Combined values from FCID's Canal Efficiency Improvement's WaterSMART grant application and Phase 2 Rubicon Gates WSF application (number 5213).
2. Combined values from NBID's Superior and Courtland Canal Automation and Superior Canal Delivery Efficiency Improvement WaterSMART grant applications.
3. $528,643 from WSF and $2,000,000 from WRCF.
4. Funding sourced from WRCF.

Conjunctive Management

In 2019, MRNRD signed a long-term lease agreement with FVID. Under the agreement, MRNRD compensates FVID in the amount of $112,000 per year, and FVID agrees to utilize their water delivery system and appropriations as requested by MRNRD when conditions allow and compliance with other agreements can be maintained. Potential aspects of this joint project include delivery of surface water, creating ground water recharge, and flow augmentation to the Republican River for Compact compliance and credits. MRNRD has also worked with irrigation districts including FVID and FCID on efficiency and infrastructure improvements.

During the Analysis Period, LRNRD began development of a project which will involve construction of wells and a delivery system to supply streamflow augmentation water to Flag Creek (and ultimately the Republican River). If initiated, the impact of this project will be assessed during the next Five-Year Technical Analysis.

UR/MR/LRNRD continue to provide joint funding for N-CORPE under the associated interlocal cooperative agreement, which also includes Twin Platte NRD (TPNRD). N-CORPE can be used to supply augmentation water to the Republican River as-needed to maintain Compact compliance. N-CORPE wells and decertified acres are located in MRNRD and TPNRD. For further information, see the N-CORPE website. There was no pumping for Compact compliance for this project during the Analysis Period.

Mapping and Modeling
Throughout the Analysis Period, NeDNR worked with URNRD and MRNRD to fund multiple contracts for the development of detailed maps and models of groundwater within the district. The maps and models developed were used for educational purposes, decision making and projecting aquifer response to different withdrawal rates. Funding for these contracts is summarized in Table 19.

Table 19. Summary of funding used to create maps and models of Basin groundwater during the Analysis Period.

NRD	Local Funds	State Funds[1]
URNRD	$162,000	$243,000
MRNRD	$1,339,109	$2,008,663

1. State funding sourced from WSF.

Objective 2.3: Provide opportunities for collaboration among Basin water users

Action Item 2.3.1: Hold annual meetings to discuss Plan implementation and exchange information
During the Analysis Period, annual meetings were held between NeDNR and the NRDs to discuss Plan implementation and exchange information about the Basin. The Plan's former stakeholder advisory committee was invited to these meetings, which were also open to the public. These meetings provided opportunities for Basin water users to collaborate.

Action Item 2.3.2: Cooperatively address water-user conflicts from Plan implementation
During the Analysis Period there were no conflicts between water users resulting from Plan implementation. If such conflicts arise in the future, they will be addressed following the procedures outlined in Appendix E of the Plan.

Objective 2.4: Promote available conservation programs

Action Items 2.4.1/2: Collaborate to identify and promote conservation programs
Throughout the Analysis Period, the Basin NRDs and NeDNR discussed and shared information regarding existing and potential new incentive programs to promote water conservation as new information became available or new proposals were raised. The evaluation of these program opportunities included consideration of whether and how they might aid in achieving Plan goals and objectives. Some examples of such programs include CREP, TBNRD's WCIP Program, and the telemetry meter/soil moisture

programs in UR/MR/LRNRD. More information on these programs is available in the section for Objective 2.2. above.

Announcements and educational materials relating to the conservation programs described above were jointly developed by NeDNR and the Basin NRDs and presented to stakeholders and the public during the Analysis Period. This information was disseminated at events such as the annual meetings described in the section for Action Item 2.3.1, and via the various mediums of communication described in the section for Action Item 3.1.1.

Objective 2.5: Understand impact of independent decision-makers on water supply

Action Item 2.5.1: Study effects of conservation practices on streamflow
See the literature review report located in the "Plan Implementation" section of the Plan website and the summary of that study in the Conservation Practices section of this report above.

Action Item 2.5.2: Analyze future impacts to stream flow of past pumping and associated lag time
A lag time analysis was conducted as part of this Analysis. See the summary of results in the Analysis Results section of this report above (Action Item 2.5.2).

Action Item 2.5.3: Conduct watershed study to evaluate impacts of all inputs/outputs on water balance
This action item is to be completed by 2028. Some efforts toward completing this action item were undertaken during the Analysis Period. URNRD partnered with UNL and the Nebraska Water Alliance to collect water-input data within the HUC-12 watershed of Perkins County. MRNRD received a WSF Grant to use airborne electromagnetic (AEM) technology to model water supply balance in the whole irrigated portion of the district. See the 2019-2022 Plan annual reports for further details.

Objective 2.6: Evaluate feasibility and potential outcomes of water markets

Action Item 2.6.1: Cooperate in determining feasibility
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. Then 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 preliminary results of this feasibility analysis were presented at the basin-wide plan annual meeting held on November 15, 2023 and summarized in the 2022 Basin-Wide Plan Annual Report. The feasibility analysis is being finalized and will be posted online when it is completed.

Action Item 2.6.2: Following feasibility analysis, test conclusions if feasible
Based on survey results and the feasibility analysis described above, NeDNR and the Basin NRDs do not plan on conducting a water market pilot program.

Objective 2.7: Support NRDs in managing allocations, irrigation districts in managing surface water supply allotment

Action Items 2.7.1/2: Evaluate systems, recommended any changes/improvements as needed
See the discussion of the surface water allotment and groundwater allocation systems in the Current Uses section of this report above.

Objective 2.8: Conserve water for future use during a drought

Action Items 2.8.1/2: Conduct Basin drought-planning exercise, evaluate results
The four Basin NRDs and NeDNR partnered with the National Drought Mitigation Center to develop and participate in a drought planning exercise, which was held in May of 2022. Goals of the exercise included:

- Increasing understanding of the need for and logistics of storing water for use during a drought.

- Evaluating 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.

The exercise included drought scenarios developed from a drought impacts survey of Basin stakeholders, a questionnaire sent to NRD managers, the 2021 Forecast of Allowable Depletions, and data from other drought monitoring tools. These drought scenarios were included in the exercise to promote coordination and collaboration among Basin stakeholders, identify potential opportunities for better drought preparedness, expand participant knowledge of drought mitigation strategies, and assess current drought mitigation strategies for possible shortcomings. The scenarios primarily focused on actions needed to maintain Compact compliance, interactions between agencies, communication with the public, and identifying policy gaps. Drought scenarios also involved examining conservation methods, emergency response, and economic stability.

Conducting the exercise resulted in an increased knowledge of organizational responsibilities during drought, methods used to maintain Compact compliance during drought, and resources available during drought. Specific updates to the Plan or IMPs were not identified from evaluation of the exercise results. However, participants identified a Basin-specific drought plan and drought information dashboard as potential tools to help manage water and improve resource coordination during periods of drought. NeDNR and the Basin NRDs will coordinate on potentially developing and implementing these tools if such an effort is determined to be feasible, beneficial, and sufficient staff and resources are available.

Objective 3.1: Improve information sharing

Action Item 3.1.1: Utilize existing resources to share with outside entities

The Basin NRDs and NeDNR disseminated information using resources such as newsletters, radio broadcasts, public meetings, websites, social media, and education/outreach events. The Plan website provided information about Plan implementation, background information, and data resources. Basin NRDs regularly shared information about their activities related to Plan implementation and maintaining Compact compliance on their respective websites. All four NRDs produced public newsletters with information about their activities and LRNRD also provided information through radio publications.

Action Items 3.1.2/3.1.3: Educate civic leaders/public

Throughout the Analysis Period, NeDNR and Basin NRDs participated in numerous education and outreach activities. These efforts aimed to inform civic leaders and the public about the implementation of the Plan and the policies and institutional frameworks that contribute to the implementation of solutions.

MRNRD participated in the McCook Farm and Ranch Show, and published information about remote irrigation monitoring in Irrigation Leader Magazine. LRNRD and TBNRD continued to co-host the annual South-Central Nebraska Water Conference with CNPPID to inform the public about the state of water management. NeDNR developed an ESRI story map presenting information on WRCF projects, including irrigation efficiency projects within the Basin.

NeDNR and Basin NRDs communicate regularly with their legislative representatives and other state senators, as needed. NeDNR gave multiple presentations about aspects of the integrated management planning process and legislation at an American Water Resources Association conference. NeDNR and colleagues from Kansas and Colorado maintain a website with information about the Compact, which includes background information about the RRCA, annual reports, and other materials. URNRD updates their website with Compact developments and provides an accessible explanation of the Compact and compliance efforts.

Action Item 3.1.4: Promote/support changes in laws/policies/rules to incentivize reduced consumption
Throughout the Analysis Period there were no proposed changes to laws, policies, and rules that would incentivize reduced water consumption. NeDNR and 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 viability of the region in accordance with the mission of the Plan.

Objective 3.2: Improve information sharing with Basin water users

Action Items 3.2.1/2/3/4: Share Compact data with public, share annual reports on water supplies/uses, keep former stakeholder advisory committee updated, encourage/support information sharing on water management improvements
NeDNR and all four NRDs shared data and information about water supplies and uses in the Basin in annual reports on Plan progress. This information was shared with the public at basin-wide plan annual meetings and on the Plan website. Information about Plan implementation was also shared with the former stakeholder advisory committee and other interested parties through a GovDelivery contact list. NeDNR and the NRDs worked together on updates to IMPs to ensure consistency between IMPs and the Plan.

NeDNR and the NRDs encouraged and supported water users within the Basin to share information about their management practice improvements with other water users and the public. UNL aggregated water use data from UR/MR/LRNRD and shared it with irrigators, so they could understand how their water usage compared with others in the immediate area. NeDNR and 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 efficient crop production.

Objective 4.1: Protect and enhance fish/wildlife habitat, recreation opportunities

Action Items 4.1.1/2/3: When feasible partner with relevant organizations, promote recreation, cooperate in projects to assess/restore riparian wetlands
Throughout the Analysis Period, Basin NRDs partnered with organizations on projects which protected and enhanced natural habitat, promoted recreation, or restored riparian wetlands. URNRD restored 2,500 formerly irrigated acres in Dundy County to native grassland, providing natural habitat and public hunting opportunities. MRNRD partnered with Pheasants Forever to restore habitat through wildlife plantings. LRNRD provided funding to plant native habitat on center pivot corners and leased office space to the Nebraska Game and Parks Commission. TBNRD worked with CNPPID to deliver excess Platte flows to federally managed wetlands near the Basin, enhancing habitat for migratory waterfowl.

Objective 4.2: Where feasible/beneficial reduce effects of undesirable vegetation on water conveyance

Action Item 4.2.1: Cooperate in removing undesirable vegetation
Throughout the Analysis Period, Basin NRDs provided financial support to weed management districts for the removal of invasive vegetation and noxious weeds throughout the Basin. This included the restoration of riparian wetlands. The efforts of these districts protected native biodiversity and improved the ability of stream channels to convey water unimpeded by dense vegetation.

URNRD and MRNRD financially supported the Southwest Weed Management District and assisted in its reorganization in 2019 to improve oversight and efficiency. The district utilized grants to cost-share the removal of invasive species such as Russian olive and eastern red cedar trees in stream corridors. LRNRD financially supported the Twin Valley Weed Management district. The Twin Valley Weed Management District removed invasive vegetation and planted desirable native vegetation. Some examples of their

work included regular spraying of Phragmites, controlled burns of vegetated islands in the Republican River channel, and the restoration of wildflowers to benefit local pollinator species.

Public Comments

No public comments were received after findings were presented at the basin-wide plan annual meeting held on November 15, 2023.

Modifications to the Plan

No modifications to the Plan were proposed.

Glossary

Abbreviation	Term	Definition
	Analysis Period	The period of time for which implementation of the Plan is being evaluated (2019-2022). This period is only four years due to the requirements of the analysis time frame, and the cycle for reporting and approval of official RRCA data, which was the basis for this Analysis.
	Annual Forecast of Allowable Depletions	Each year, in compliance with Neb. Rev. Stat. § 46-715(6), NeDNR, in conjunction with the Basin NRDs, forecasts the maximum amount of water that may be available from streamflow for beneficial use in the short term and long term to comply with the Compact.
	Augmentation	Supplementing or replacing surface water in a basin, subbasin, or reach through actions including, but not limited to, groundwater pumping and inter-basin surface water transfers.
	Basin NRDs	NRDs that contain some portion of the Basin, including URNRD, MRNRD, LRNRD, and TBNRD.
Plan	Basin-Wide Plan	The plan developed by NeDNR and the Basin NRDs, in consultation and collaboration with a stakeholder advisory committee, to fulfill requirements of Neb. Rev. Stat. § 46-755.
	Basin-Wide Plan Annual Meeting	Public meeting held annually by NeDNR and NRDs to discuss Plan implementation and exchange information about the Plan.
	Compact Accounting	Computation of water supplies/uses and allocations following the Accounting Procedures.
CCY	Compact Call Year	A year in which NeDNR's analysis following the forecast procedures contained in the *Monitoring & Studies Technical Memorandum for the URNRD, MRNRD, and LRNRD IMPs* indicate the potential for noncompliance with the Compact if sufficient management actions are not taken.
CBCU	Computed Beneficial Consumptive Use	For purposes of Compact accounting, the streamflow depletion resulting from the activities of man that are specified in the Accounting Procedures.
	Conjunctive Management	Using surface water and groundwater in combination to improve water availability and reliability, primarily through conserving or changing the timing of the flow of existing water sources by shifting when and where it is stored; does not result in new sources of water.
	Decertification	Revocation of irrigable status for a formerly certified parcel of land, either permanently or for a pre-determined number of years.
	Depletion	A decrease in computed streamflow between an RRCA groundwater model run that includes the activities of man (e.g., groundwater pumping for irrigation) and a modeled scenario in which those activities are not included to represent a baseline condition.

Abbreviation	Term	Definition
FSS	Final Settlement Stipulation	An agreement entered into by the states of Kansas, Nebraska, and Colorado on December 15, 2002, to resolve litigation in the United States Supreme Court regarding the Compact. The FSS defines how compliance with the Compact's requirements will be determined including detailed accounting procedures and the use of a jointly developed groundwater model.
Analysis	First Five-Year Technical Analysis	The first technical analysis of progress towards achieving the goals and objectives of the Plan during the preceding five-year period completed in 2023.
IMP	Integrated Management Plan	Document jointly developed by NeDNR and an NRD outlining the framework for joint management of hydrologically-connected surface and groundwater to fulfil the requirements of Neb. Rev. Stat. § 46-715.
LRNRD	Lower Republican NRD	A Natural Resources District of Nebraska located within the counties of Furnas, Harlan, Franklin, Webster, and Nuckolls.
MHO	Measurable Hydrologic Objective	A quantifiable target, related to the movement and distribution of water, used to evaluate the extent to which reasonable progress is made toward achieving the final goals and objectives of the Plan.
MRNRD	Middle Republican NRD	A Natural Resources District of Nebraska located within the counties of Lincoln, Hayes, Frontier, Hitchcock, and Red Willow.
	Moratorium	In the context of groundwater and surface water rights, a legally authorized suspension of drilling of groundwater wells, development of additional irrigated cropland, or approval of new surface water appropriations.
NeDNR	Nebraska Department of Natural Resources	A state agency with responsibilities in the areas of Surface Water, Groundwater, Floodplain Management, Dam Safety, Natural Resources Planning, Integrated Water Management, Storage of Natural Resources and Related Data, and Administration of State Funds.
NRD	Natural Resources District	Local government entity of the state with broad responsibilities to protect Nebraska's natural resources within their subdivision.
	Offset	A reduction in water use or an increase in water supply that corresponds with an increased use of water, for the purpose of balancing water uses and supplies; also referred to as mitigation.
	Phreatophytes	Deep-rooted plants that obtain a portion of their water supply from groundwater. Phreatophytes comprise a large portion of riparian vegetation within the Basin.
	Rapid Response Area	An area designated in the IMPs and rules and regulations for UR/MR/LRNRD in which additional groundwater regulations may be applied during a CCY if necessary to maintain compliance with the Compact.
Basin	Republican River Basin	The drainage area for the Republican River.
Compact	Republican River Compact	An agreement between Colorado, Kansas, and Nebraska that allocates consumption of the waters of the Basin among the three states.

Abbreviation	Term	Definition
RRCA	Republican River Compact Administration	Entity comprised of one commissioner from each of the three states party to the Compact (Colorado, Kansas, and Nebraska) created to administer the Compact as specified in Article IX, therein. For further information see the RRCA website.
	RRCA Groundwater Model	The computer-based groundwater model developed under the provisions of the FSS and subsequently adopted and revised through action of the RRCA.
Accounting Procedures	RRCA Accounting Procedures and Reporting Requirements	Data requirements/reporting format and calculation methodology to be used by the RRCA to compute allocations/consumptive uses to assess Compact compliance. Originally created as part of the FSS in 2002, these procedures have been updated as approved by the RRCA in 2015, 2016, and 2017. The most recent version of the approved documentation describing these procedures was issued August 21, 2020.
	Stakeholder Advisory Committee	The group of individuals with a water interest in the Basin that was formally assembled for the purpose of collaborating with NeDNR and the NRDs on the development of the Plan.
TBNRD	Tri-Basin NRD	A Natural Resources District of Nebraska located within the counties of Gosper, Phelps, and Kearney.
URNRD	Upper Republican NRD	A Natural Resources District of Nebraska located within the counties of Perkins, Chase, and Dundy.
	Water Market	An economic platform for temporary or permanent trades of the rights to use water, where the price of water is determined by variable economic and market conditions.
	WaterSMART grant	Grant from USBR to fund projects that seek to conserve and use water more efficiently and accomplish other benefits that contribute to sustainability in the western United States. For further information see the WaterSMART page on the USBR website.
WRCF	Water Resources Cash Fund	A state trust fund managed by NeDNR which was created in 2007 to aid management actions to reduce consumptive use in overappropriated or fully appropriated areas, and to aid in implementing short- and long-term water management activities to assist in complying with statutory requirements and requirements of interstate compacts. WRCF-funded projects must contribute toward at least one of three water conservation goals including reducing consumptive water use, enhancing streamflow, and recharging groundwater.
WSF	Water Sustainability Fund	A state trust fund administered by the Natural Resources Commission (NRC) to provide financial assistance to eligible projects, programs, or activities that lead to sustainability of Nebraska's water resources. NeDNR administers the fund by reviewing newly filed applications and forwarding those that meet requirements to the NRC, entering into contracts for approved projects with project sponsors, dispersing funds and monitoring project progress. Approved project applications are available for review on the NRC website.

Abbreviation	Term	Definition
WSY	Water-Short Year	Year in which the projected or actual irrigation water supply for irrigation in HCL is less than 119,000 acre-feet. This projection is calculated by the USBR. The final WSY calculation is done in July, using data collected from January through June of that year.

Supplemental Information (linked throughout)

Resource	Web Address
2021 Forecast of Allowable Depletions in the Republican River Basin	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/BasinWidePlan/Forecasts/20201231_Forecast2021and2031.pdf
Accounting Procedures	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/RRCA/2020/20200821_RRCAAcctProcedureUpdate.pdf
CCY Handout	https://rrbwp.nebraska.gov/MtgMaterials/Compact%20Call%20Year%20Handout.pdf
Compact	http://republicanriver.org/wp-content/uploads/2018/05/Compact_US-version.pdf
FSS	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/upper-platte/republican-river-compact/final-settlement.pdf
LRNRD 5th Generation IMP	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/lower-rep-NRD/20210927_5thGenIMP_LRNRD_FINAL.pdf
LRNRD Rules and Regulations	https://www.lrnrd.org/docman/docs/990-lower-republican-nrd-rules-and-regulations-and-exhibit-a-effective-01-01-23/file
Methodology for MHO B Supplement to the Plan	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/BasinWidePlan/Plan/20200220_MHOBMethodology.pdf
Methodology for MHO C Supplement to the Plan	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/BasinWidePlan/Plan/20200220_MHOCMethodology.pdf
Monitoring & Studies Technical Memorandum for the URNRD, MRNRD, and LRNRD IMPs	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/upper-rep-NRD/20210927_RrTechnicalMemorandum_FINAL.pdf
MRNRD 5th Generation IMP	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/middle-rep-NRD/20210927_5thGenIMP_MRNRD_FINAL.pdf
MRNRD Rules and Regulations	https://www.mrnrd.org/sites/default/files/page_attachments/middle_republicannrd_20230327_174342.pdf
N-CORPE	https://www.ncorpe.org/
Plan	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/BasinWidePlan/Plan/20190124_RRBWP_FINAL.pdf
Plan website	https://rrbwp.nebraska.gov/

Resource	Web Address
Report on the Republican River Basin Drought Planning Exercise	https://rrbwp.nebraska.gov/MtgMaterials/20231115_RRBW_DroughtFinalReport_FINAL.pdf
RRCA website	http://republicanriver.org/
RRCA Data and Modeling	https://www.republicanrivercompact.org/
IMP annual reports for the portion of TBNRD in the Basin	https://dnr.nebraska.gov/water-planning/tri-basin-nrd
IMP for the portions of TBNRD in the Basin	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/tri-basin-NRD/TBNRDIMP642012.pdf
TBNRD Rules and Regulations	https://www.tribasinnrd.org/sites/default/files/Rules%20%26%20Regs/GMA%20Rules%20Revision%20TBNRDFinal0921.pdf
URNRD 5th Generation IMP	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/upper-rep-NRD/20210927_5thGenIMP_URNRD_FINAL.pdf
URNRD Rules and Regulations	https://www.urnrd.org/sites/default/files/files/20/order_36_clean_for_website.pdf
USBR WaterSMART website	https://www.usbr.gov/watersmart/
WRCF Story Map	https://gis.ne.gov/portal/apps/storymaps/stories/3ff7af0cea604ca6a42a2cc2ade82e31
WSF Approved Applications Website	https://nrc.nebraska.gov/applications-satisfactory-determination-director