

# TPNRD 2023 Robust Review

April 11, 2024



# Presentation Overview

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- Integrated Water Management Overview
- Robust Review Analysis
  - Introduction
  - Updates to Model
  - TPNRD Inputs
  - TPNRD Results
- Path Forward

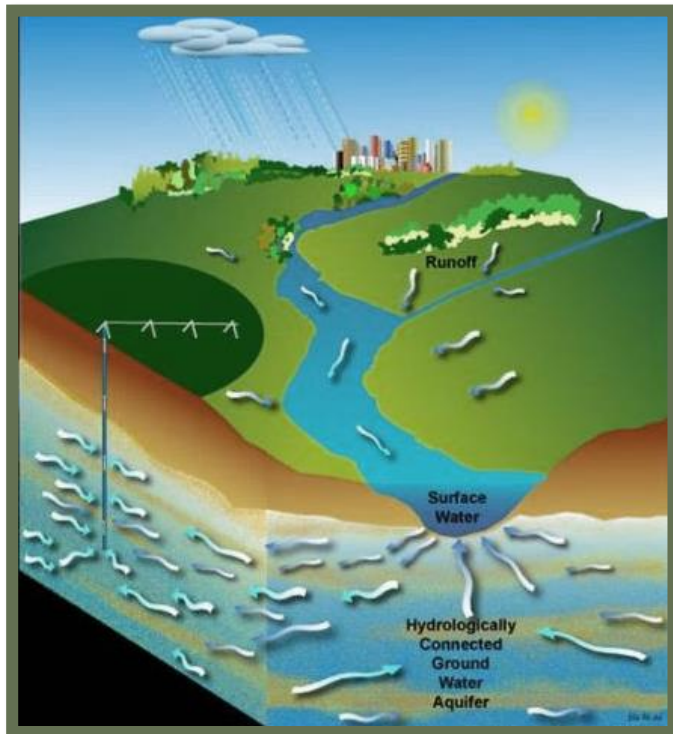




# Integrated Water Management Overview

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# Integrated Water Management - Surface Water and Ground Water Authorities



## Surface Water

- Regulated by NeDNR
- Prior appropriations
- First in time is first in right

↑  
Integrated  
water  
management  
↓

## Groundwater

- Regulated by NRDs
- Correlative rights
- Share and share alike

- 46-715(1)(a): ...jointly develop an IMP....
- 46-719: IWRB, resolving disputes between NRDs and NeDNR

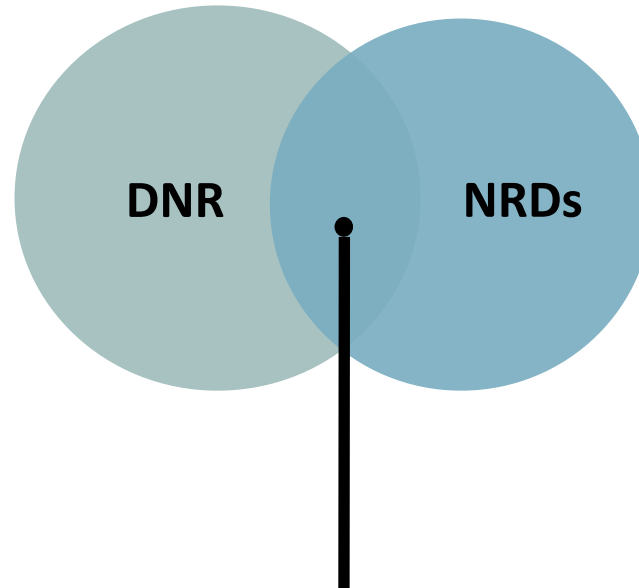
# IWM – Overview

## Roles and Responsibilities

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### DNR'S INDIVIDUAL ROLES:

- Implement and enforce surface water controls
- Provide reports on new water use and permitting activities to the NRD
- Implement surface water monitoring and data collection activities



### NRD'S INDIVIDUAL ROLES:

- Implement and enforce groundwater controls
- Provide reports on new water use and permitting activities to DNR
- Implement groundwater monitoring or data collection activities

### JOINT DNR/NRD ROLES:

- Coordinate on joint implementation aspects of the plan
- Review annual reports and data that is collected
- Conduct Robust Review and other IMP required analyses
- Keep stakeholders informed on progress towards fulfilling plan goals

# Integrated Water Management

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- Clear Goals & Objectives of BWPs & IMPs
  - Protect existing uses from negative impacts of new uses
  - Address post-1997 depletions
  - Work toward fully appropriated
  
- Meet interstate agreement compliance
  
- Ensure both the short-term and long-term balance of water supplies and uses to maintain
  - Economic viability
  - Social and environmental health
  - Safety
  - Overall welfare of the basin



# IWM – Overview

## Interstate Compliance

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### Platte River Recovery Implementation Program (PRRIP) & Nebraska New Depletion Plan (NNDP)

- The Extended First Increment extends through December 2032
- Associated Habitat Reach: Platte River from Lexington to Chapman, NE
- The Basin-wide Plan and IMPs have goals, objectives and action items to ensure compliance with the Program
- PRRIP Water Action Plan projects can be used to meet post-1997 offset requirements towards fully appropriated
- Requires annual reporting of new or expanded uses
- ✓ Requires basin-wide inventory/analysis of depletions and accretions from post-1997 new and expanded development every 5 years (Robust Review)



# IWM – Overview

## Relationship between Basin and NRD Plans

### BWP

All basin NRDs and NeDNR

Overappropriated Area

Goals, objectives, and controls:

- Focus on regional, cross-boundary issues and opportunities
- Consistency and collaboration among basin NRDs
- A broad framework used for basing IMPs

### IMP

1 NRD and NeDNR

Overappropriated and Fully appropriated areas

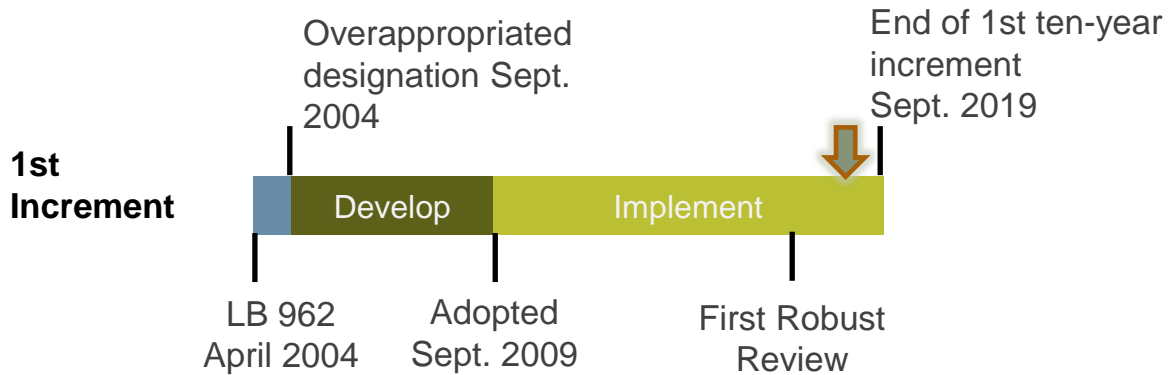
Goals, objectives, and Controls:

- Specific to the one NRD
- Tailored to local issues
- Specific targets and actions

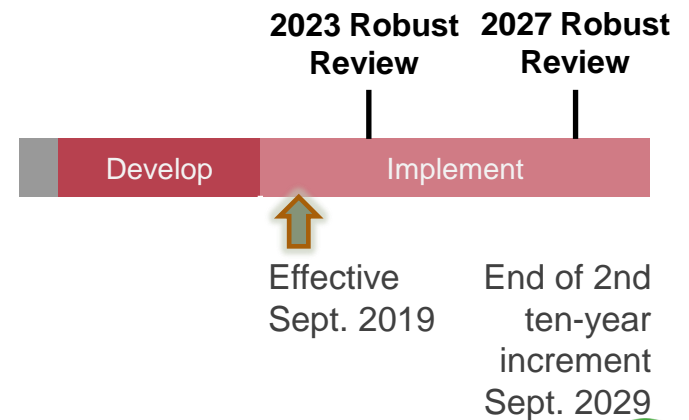




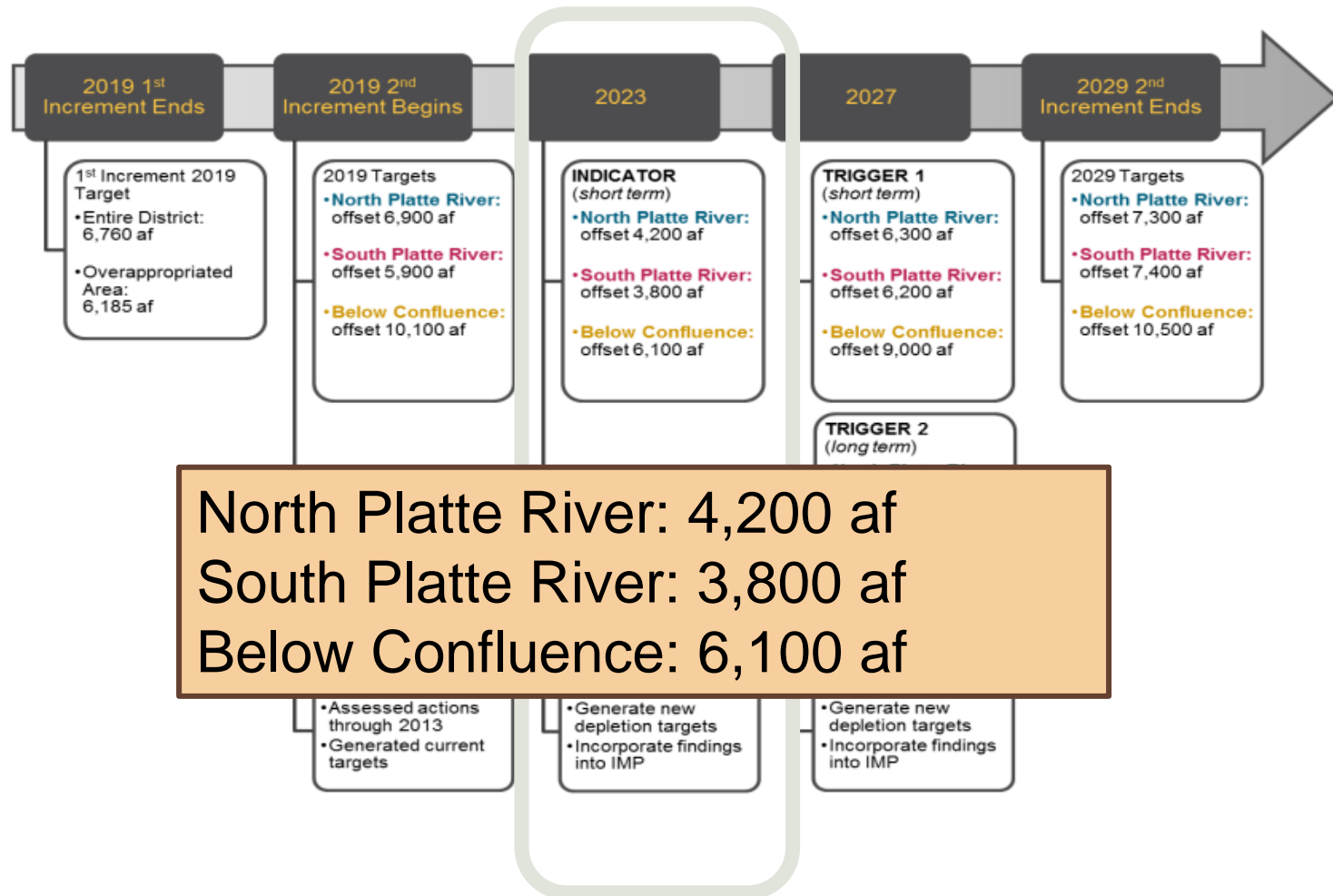
# IWM – Overview Timeline & Process



**2nd Increment**



# TPNRD IMP Requirements - Indicators



# 2023 Robust Review Analysis: Introduction

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# Previous Timeline Shared at Prior Robust Review

Tasks	2019				2020				2021				2022				2023			
	Jan. - March	April - June	July - Sept.	Oct. - Dec.	Jan. - March	April - June	July - Sept.	Oct. - Dec.	Jan. - March	April - June	July - Sept.	Oct. - Dec.	Jan. - March	April - June	July - Sept.	Oct. - Dec.	Jan. - March	April - June	July - Sept.	Oct. - Dec.
Establish data needs and requirements for water use reporting	█																			
Implement NRD rules for water use reporting	█	█																		
Develop NRD reporting system and data management requirements	█	█	█																	
Implement Phase III of conservation practices study	█	█	█	█	█	█														
Adopt second increment IMP and BWP		█	█																	
Obtain producer data based on reporting requirements and other supplemental data (power records, etc.)				█				█				█				█				█
Implement an additional 5 KAF of management actions for a total mitigation of 12 KAF by December 31, 2023	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Update landuse data (acres and crop type) through 2020								█	█	█	█	█	█	█						
Update management actions data sets through 2020 (N-CORPE pumping, recharge, Cody Dillon transfer, etc.)											█	█	█							
Evaluate model estimated pumping with water use reported data and refine modeling methods to incorporate changes								█	█	█	█	█	█							
Evaluate other water budget components such as runoff to determine if/how it will be incorporated into results								█	█	█	█	█	█							
Develop new model datasets for robust review update														█	█					
Summarize results from updated robust review for TPNRD																	█			
As necessary update IMP (targets/controls)																		█	█	█



# Robust Review: Introduction

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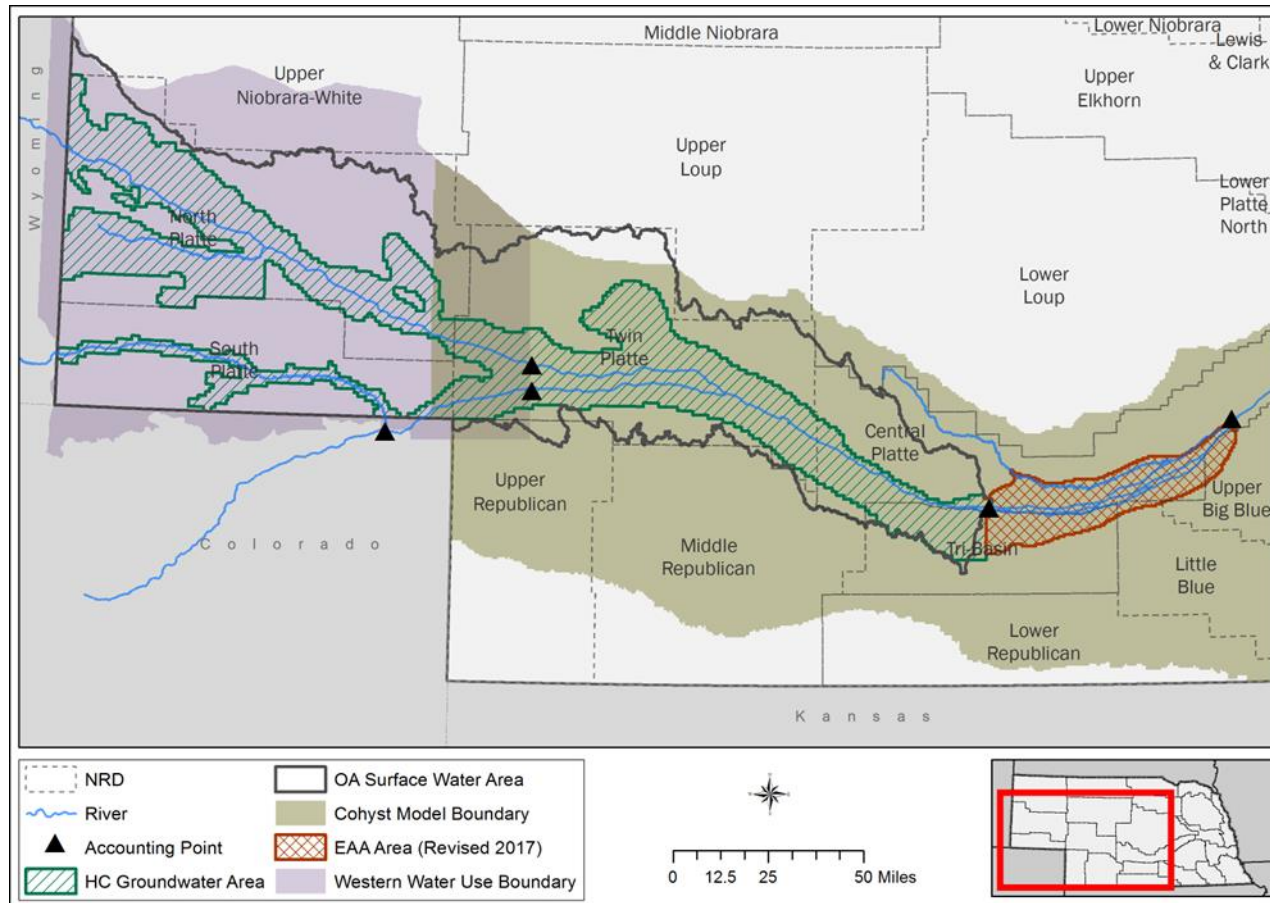
## Goals of Robust Review

- Assess progress on second increment goals and objectives (2023 Indicators)
- Assess compliance with PRRIP and NNDP
- Provide information for decision makers



# Robust Review: Introduction

## Analysis Set-Up: Map (Model Area)



# Robust Review: Introduction

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## Simulation Set-Up

- Used version 29f of the groundwater model and version 29 of the watershed model
- Model is simulated from 1950 – 2070
- Climate repeats 1996 – 2020 twice for projection period
- Historical groundwater-irrigated acres and crops are used in the historical simulation, and the 1997 level of groundwater-irrigated acres and crops are used in the “1997” simulation
- Surface water and commingled acres remain constant in the baseline and 1997 simulations to cancel out surface water and commingled effects
- Results are summarized for the South Platte River, North Platte River, and confluence downstream

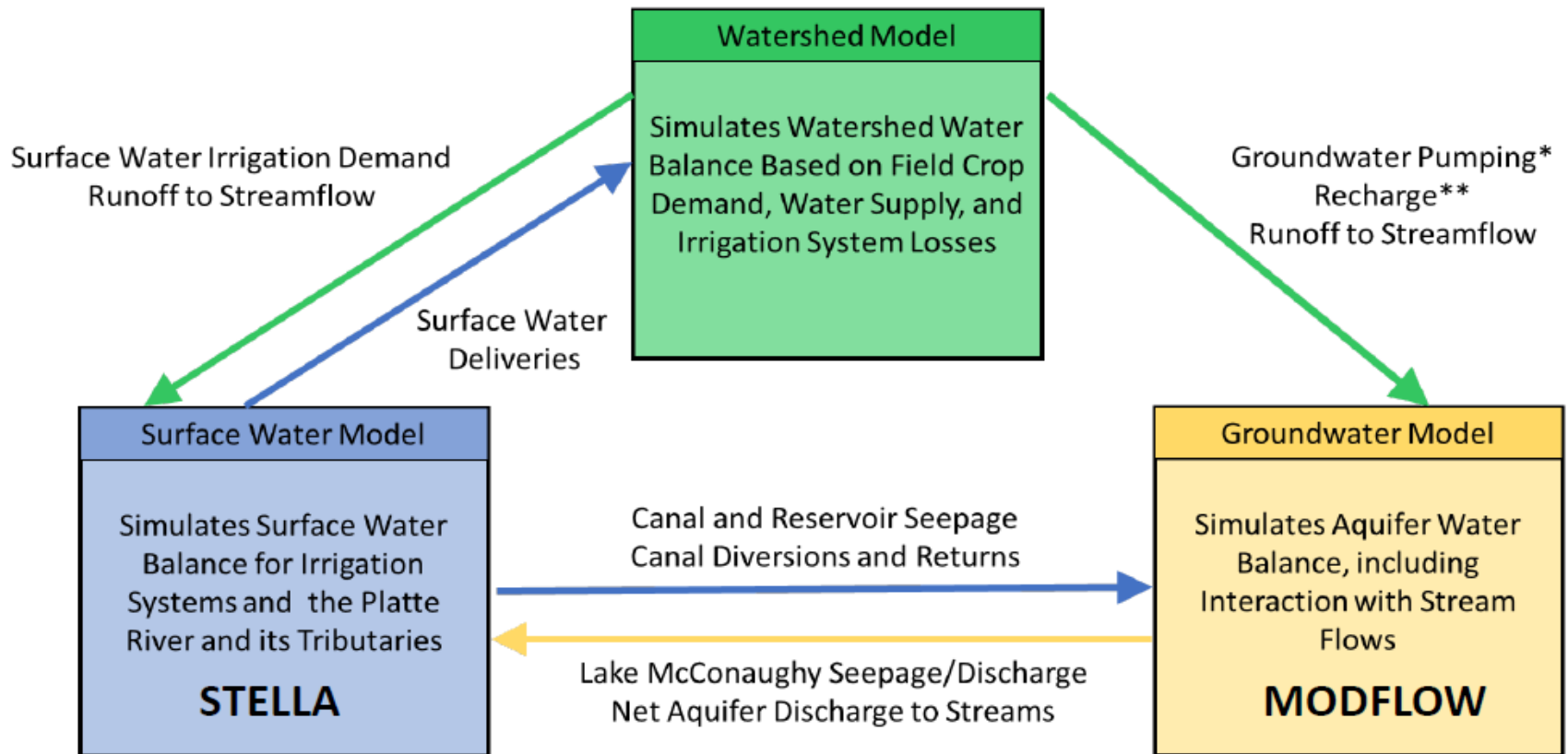


# 2023 Robust Review: Updates to Model Since 2019

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# Robust Review Analysis Updates to Model



\*Includes Irrigation and M&I Pumping, \*\* Includes Deep Percolation and Lateral Seepage



# Robust Review Analysis: Updates to Model

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## Major Differences from 2019 Robust Review

- Update input data 2014 through 2020
  - Climate data (1996 – 2020)
  - Land Use (2011 – 2020)
  - Excess Flow
  - Crops
  - Municipal and Industrial Pumping
  - NCORPE
- Update Watershed Model
  - Incorporated Conservation Study results
  - Modified crop growth specifications
  - Updated crop mixture (increased prevalence corn/soybean rotation)
- Update Groundwater Model to Modflow 6
  - New solver & pumping function
- Recalibrate Groundwater Model
- Incorporate Runoff into Groundwater Model

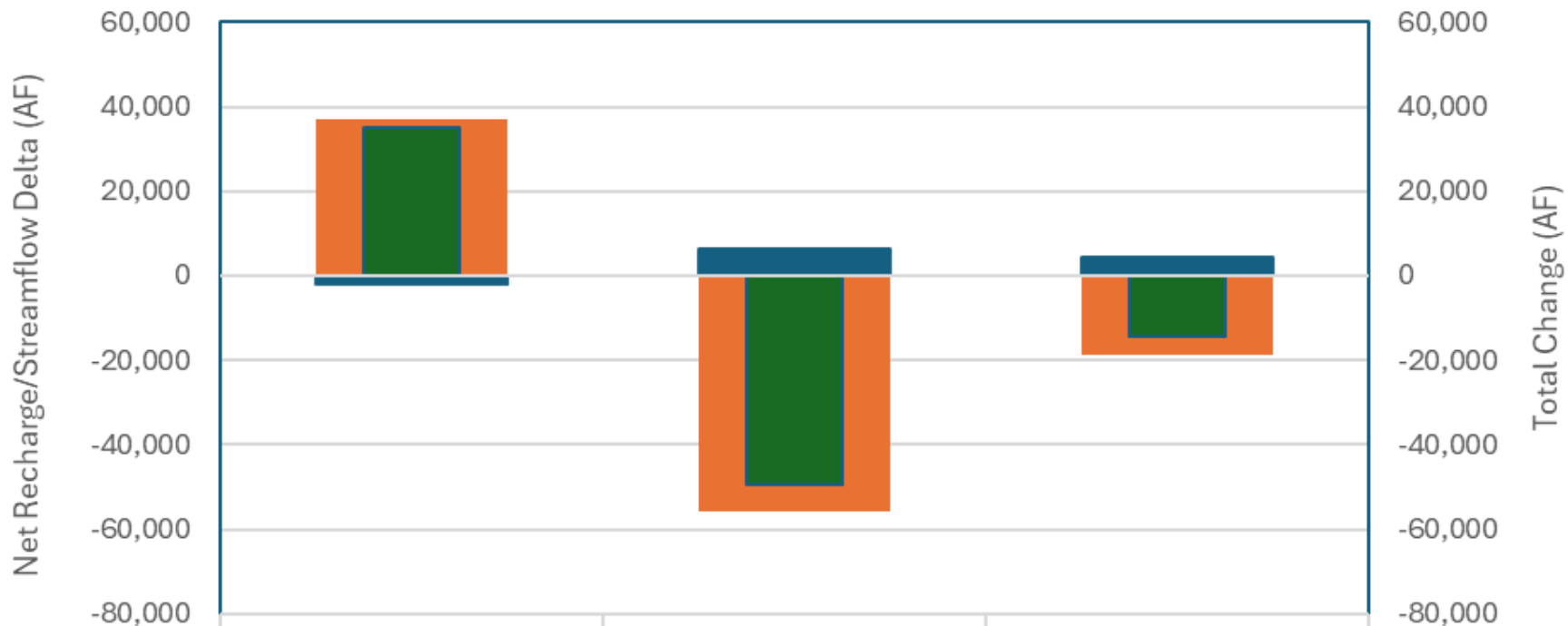


# Robust Review Analysis Updates to Model

## Impacts to Water Budget (COHYST)

- Climate Data Updates
  - **Net increase** in Water Budget - Increased precipitation/ET/field recharge & decreased pumping and field runoff
    - Replaced weather station with gridded PRISM data
- Groundwater Model Updates
  - **Net decrease** in water budget across model domain
    - Recalibration to address model updates
    - Largest change near Elwood Reservoir / Plum Creek (TBNRD)
- Watershed Model updates appear to have net effect of increased recharge
  - Updated Producer Practices
    - Tillage Practices
      - **Net increase** in WB due to increased storage, decreased pumping
      - Larger impact in eastern portion of model area due to higher precipitation
    - Adjusted Planting Dates, Growing Degree Days
      - **Net increase** in WB
    - Adjusted Crop Mix – increased prevalence corn/soybean rotation
      - **Net decrease** in WB due to decreased soybean/increased corn acres in projection period

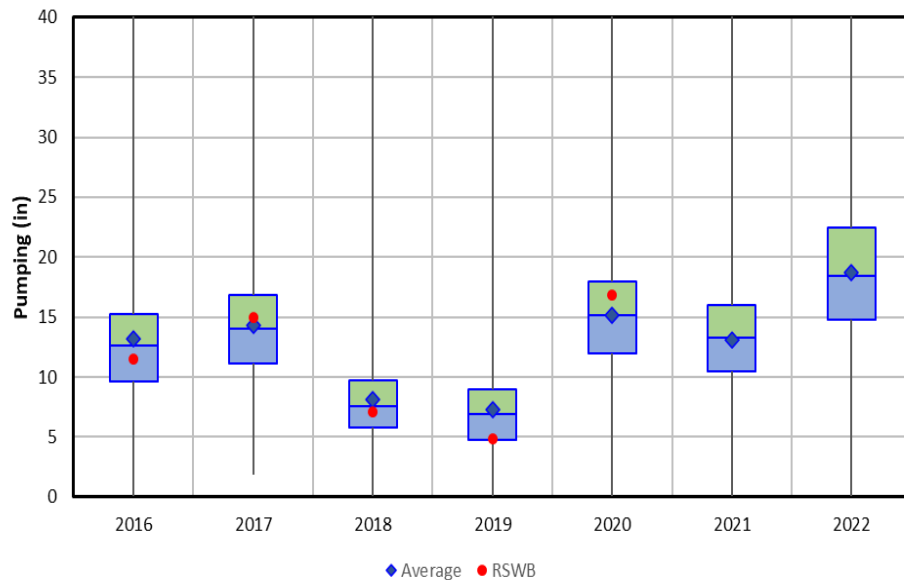
## Twin Platte NRD



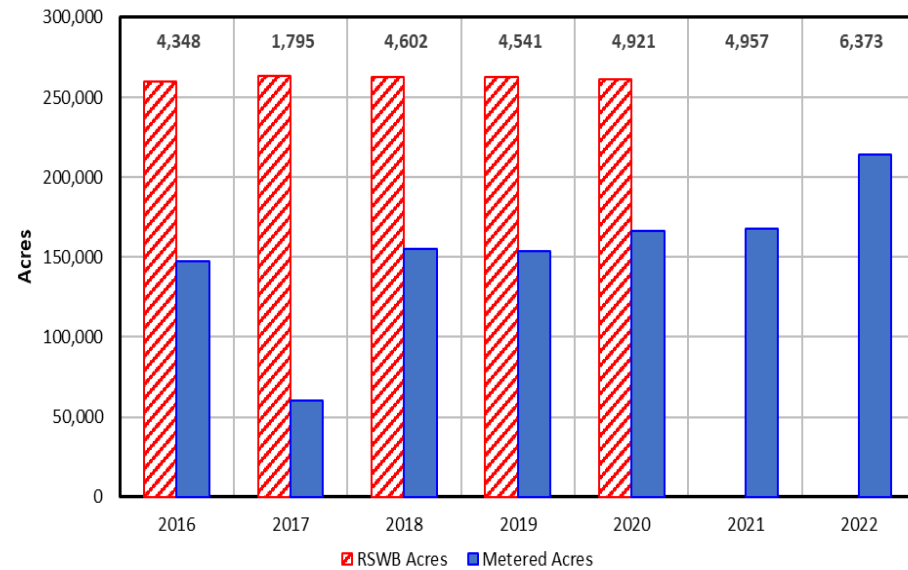
	Application of Updated Production Practices	Conversion from Dryland to Irrigated Land Use	Net Effect
Net Recharge Delta	36,950	-55,614	-18,664
Runoff to SF Delta	-1,994	6,205	4,211
Total Change	34,956	-49,409	-14,453

# TPNRD Metered Pumping to Watershed Model Estimate Comparison

TPNRD - Metered Pumping



TPNRD - GW Irrigated Acres



Note: Number values above bars indicate number of metered pumping entries available.

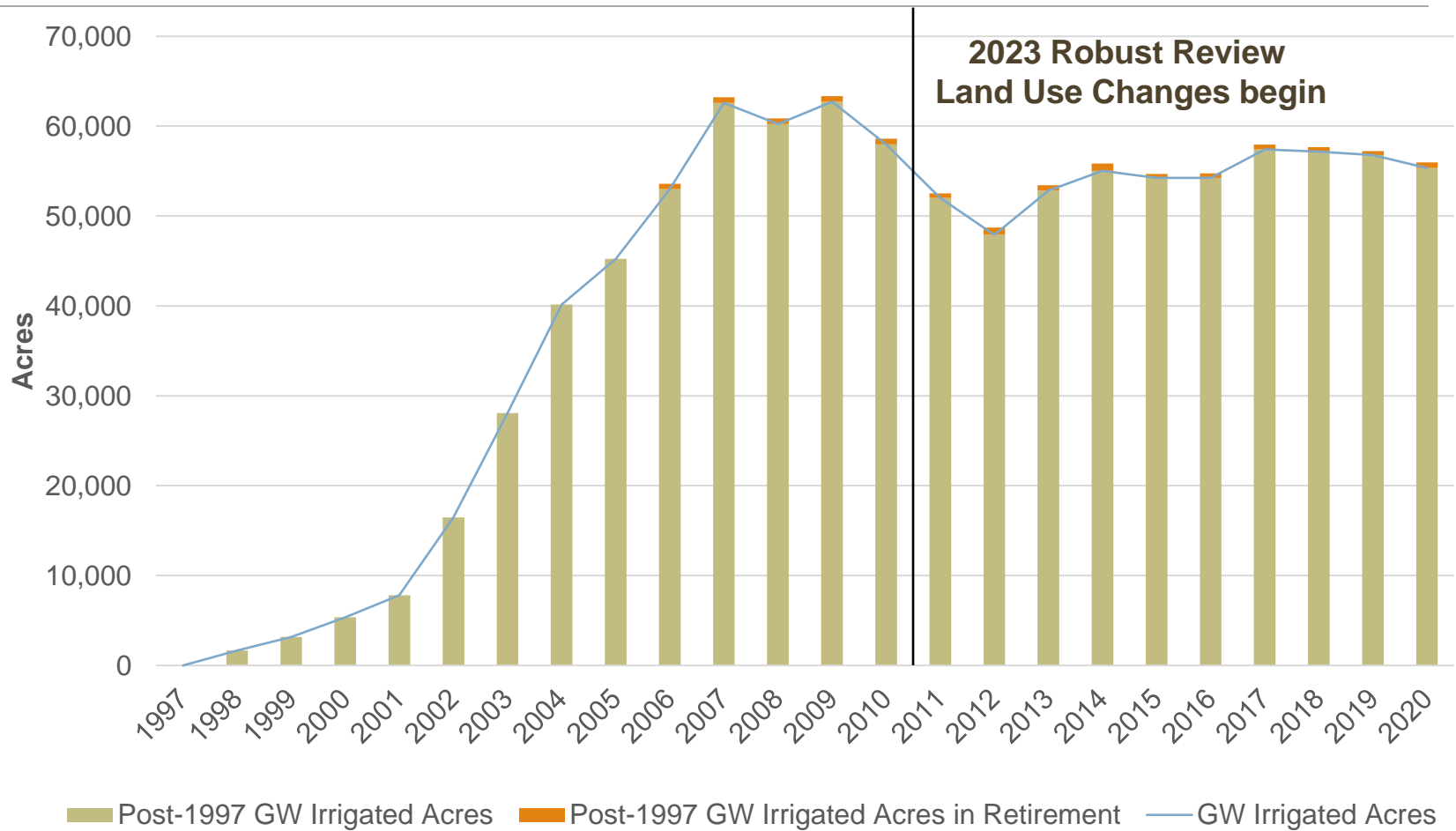


# 2023 Robust Review : Management Actions & Model Inputs

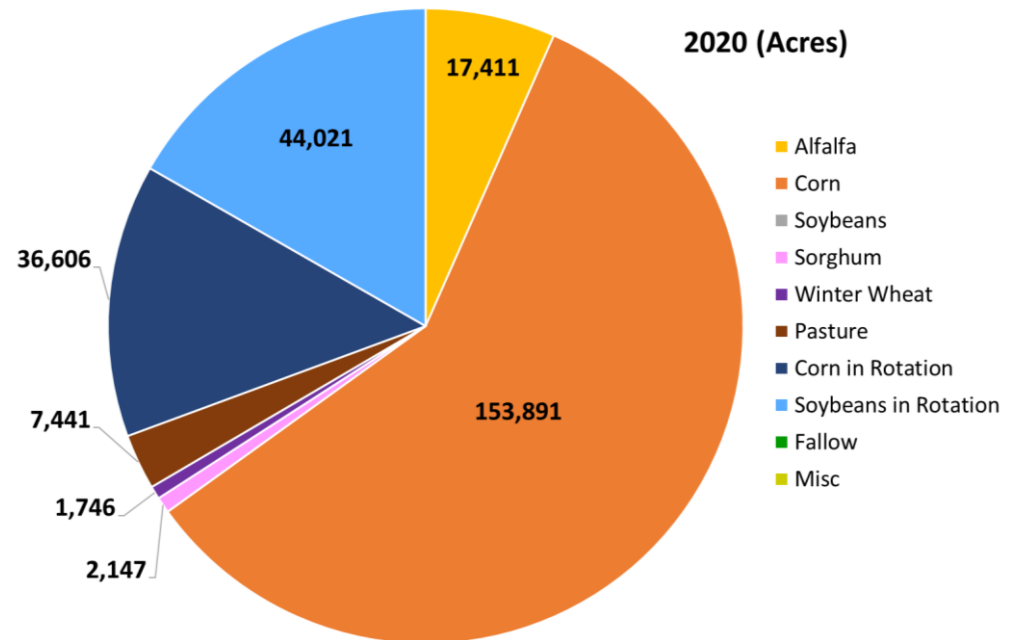
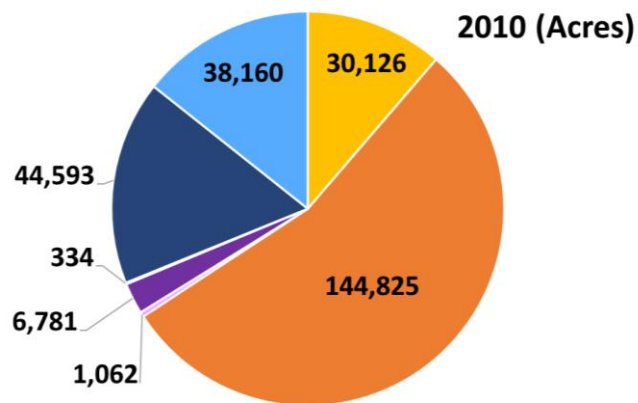
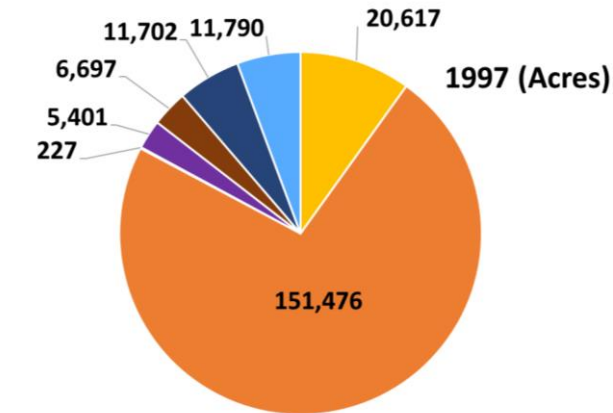
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# Management Action & Model Input:

## Net Change in Groundwater-Only Irrigated Acres 1997 to 2020



# Management Action & Model Input: Change in Groundwater-Only Irrigated Crop Types:

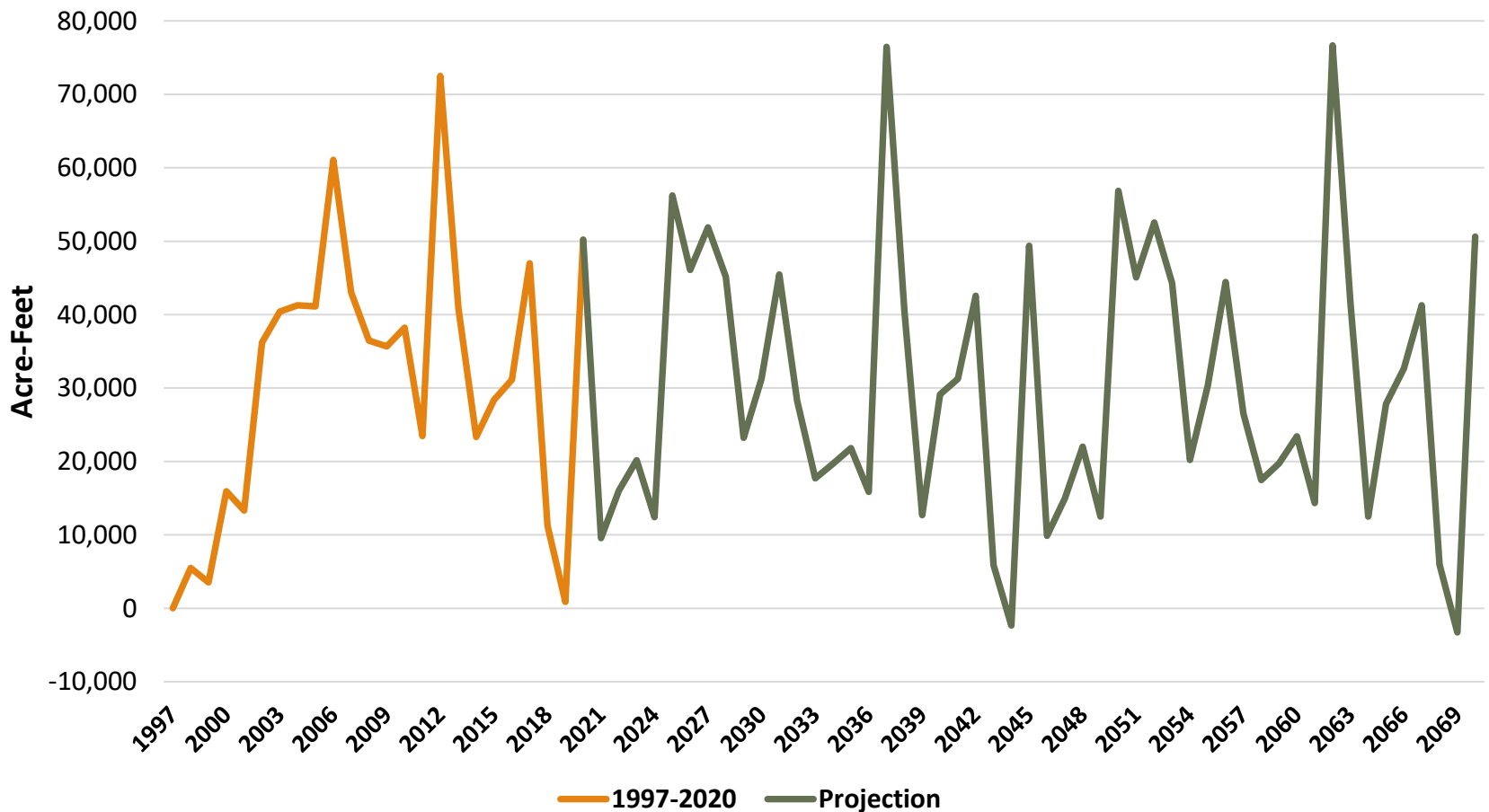


TPNRD	Total Acs	Alfalfa	Corn	Soybeans	Sorghum	Winter Wheat	Pasture	Corn in Rotation	Soybeans in Rotation	Fallow	Misc
1997	207,911	20,617	151,476	--	227	5,401	6,697	11,702	11,790	--	--
2010	265,880	30,126	144,825	--	1,062	6,781	334	44,593	38,160	--	--
2020	263,261	17,411	153,891	--	2,147	1,746	7,441	36,606	44,021	--	--
	263,261	17,411	153,891	--	2,147	1,746	7,441	36,606	44,021	--	--



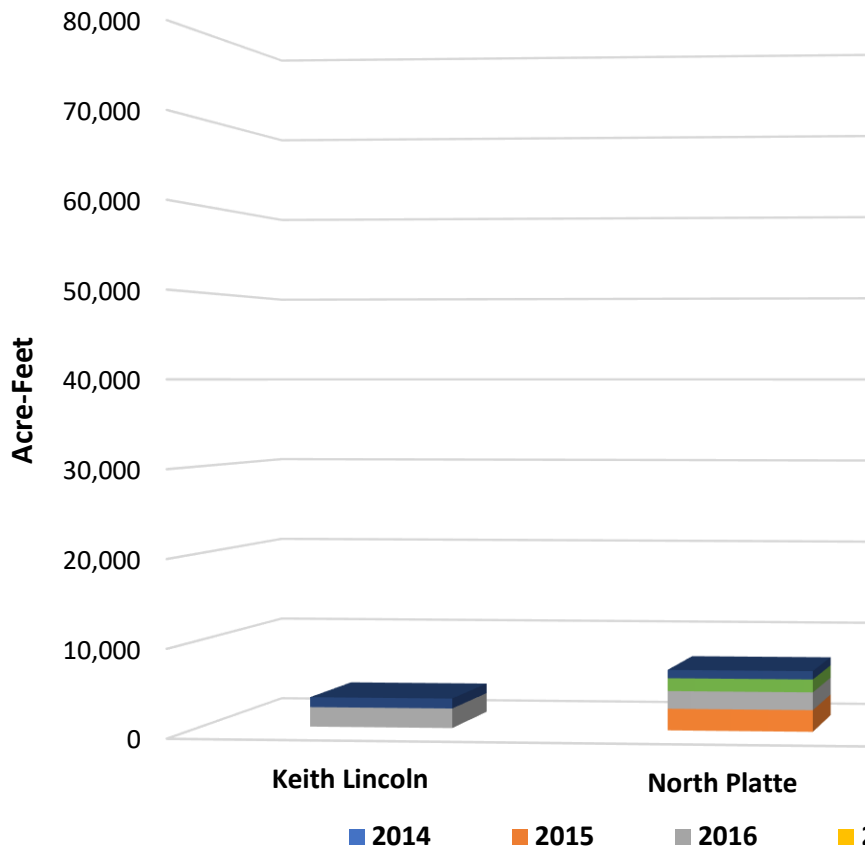


# Management Action & Model Input: Change in Post-1997 Groundwater-Only Irrigation Pumping

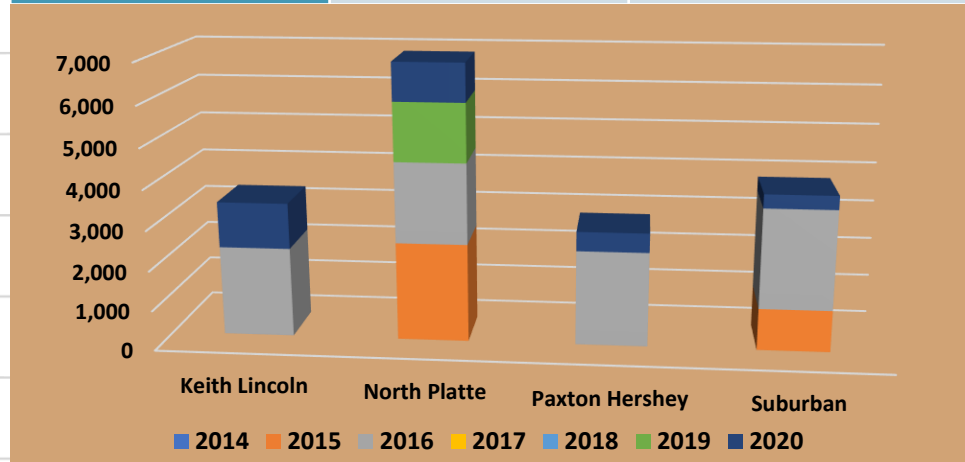


# Management Action: CWM / Excess Flows

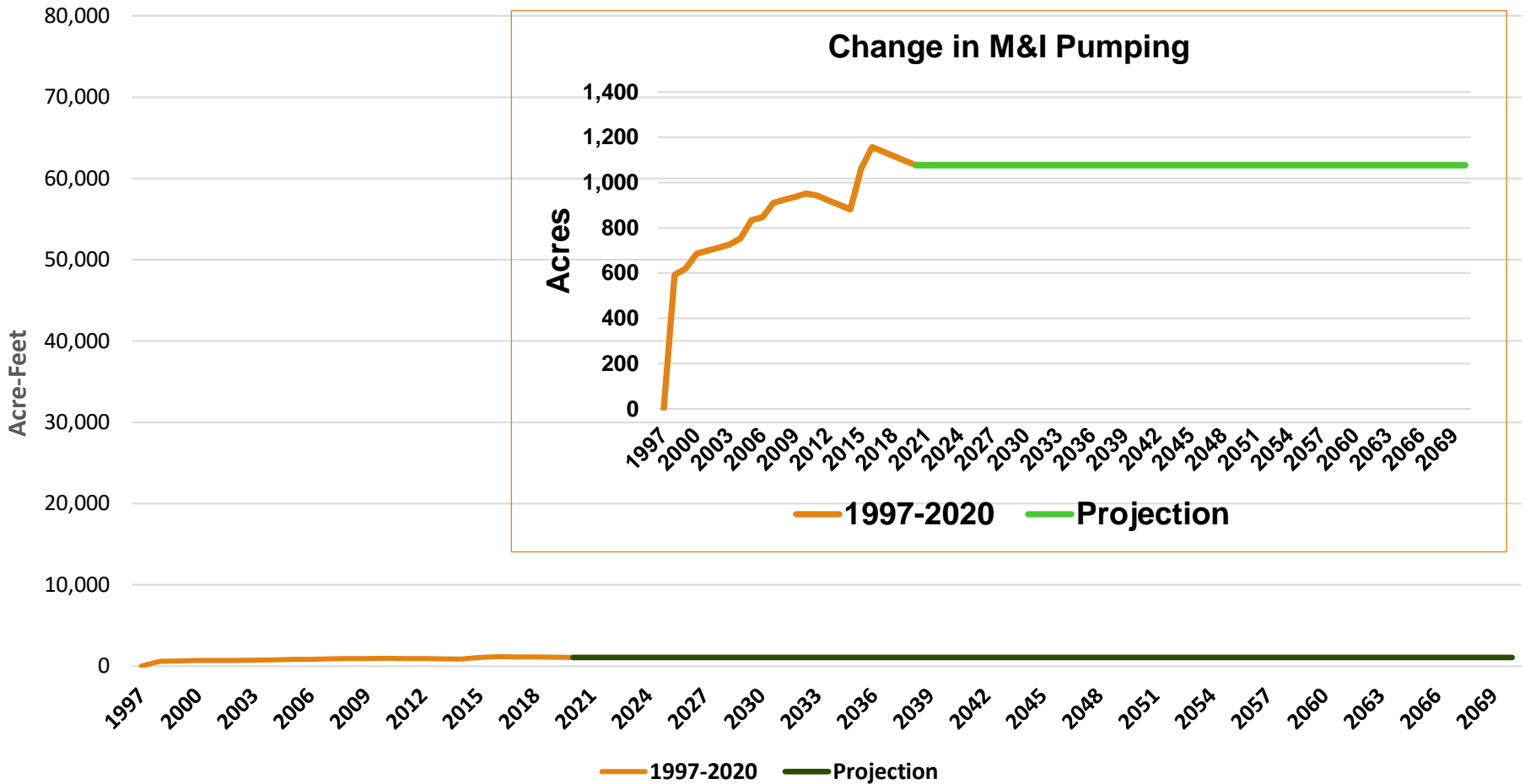
## Excess Flow Recharge



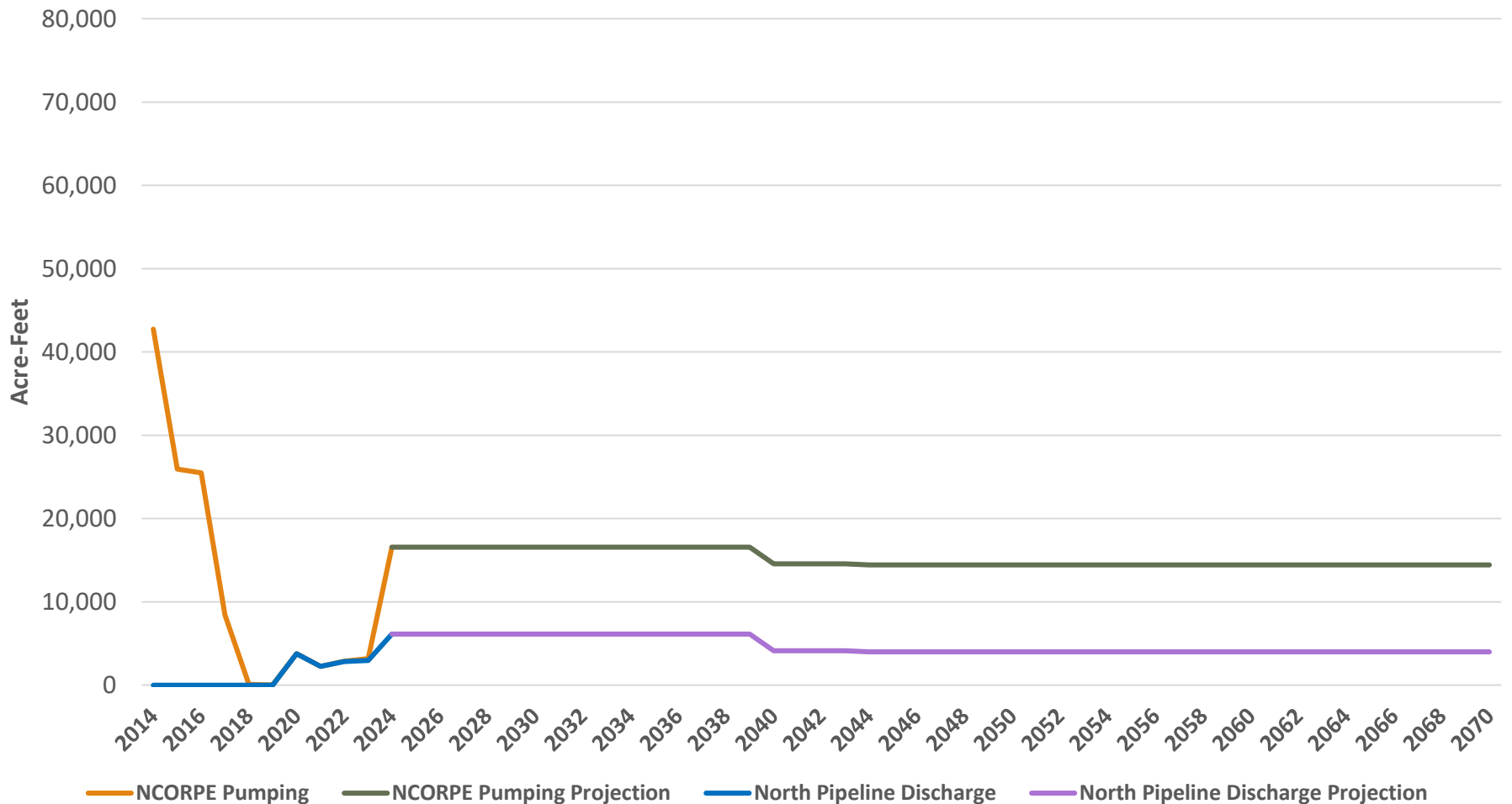
TPNRD	Acre-Feet of Excess Flow	
	Diversion	Recharge
2014 - 2020	18,220	17,226
Repeat Cycle (2011-2020)	44,777	43,041



# Management Action & Model Input: Change in Municipal and Industrial Pumping from 1997



# Management Action & Model Input: Augmentation Pumping and Discharge



# 2023 Robust Review: Analysis – TPNRD Results

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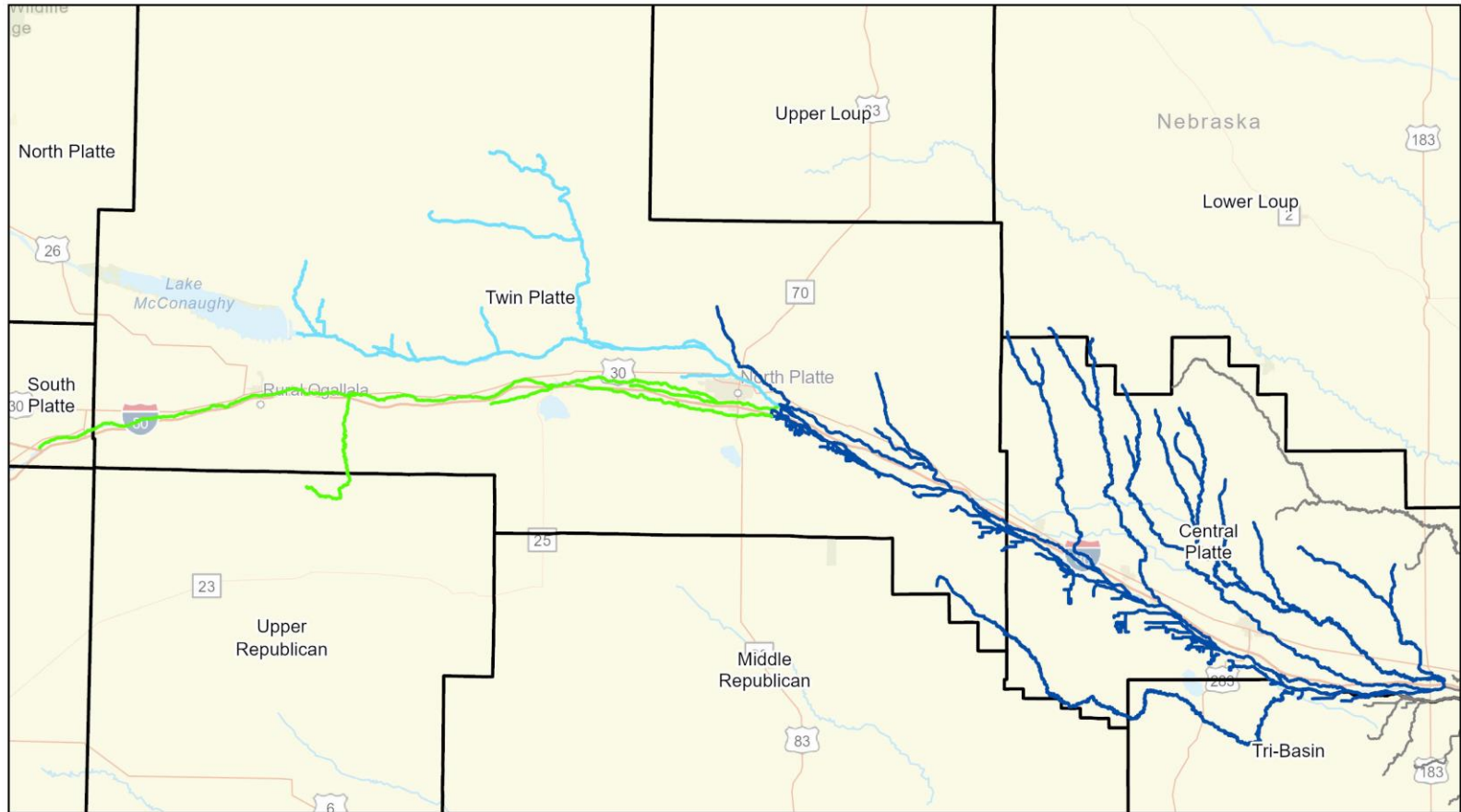
# Robust Review Analyses

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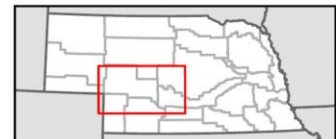
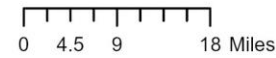
- Post-1997 Analysis
  - Post-1997 Groundwater Only Irrigated Acres Development
  - Post-1997 Municipal and Industrial Pumping Development
  - Excess Flow
  - Excess Flow Projection
  - NCORPE
  - Total Flow Analyses
  - Groundwater Only Irrigation Retirements



# TPNRD Platte River Accounting Reaches



- Confluence to Elm Creek
- North Platte
- South Platte
- Other
- NRD



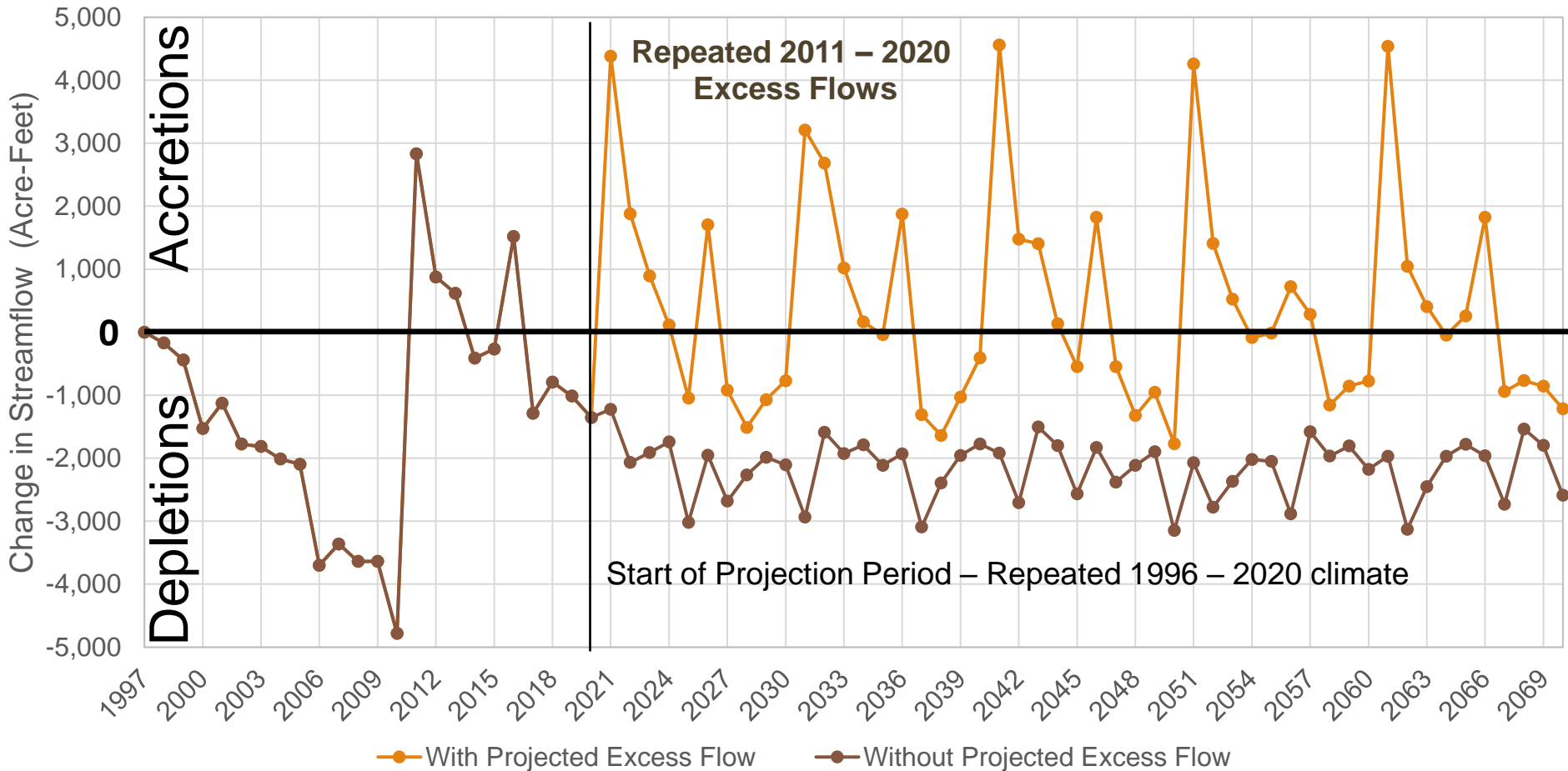
# North Platte River

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# TPNRD Results North Platte River

Robust Review Analysis Results: Post-1997 Analysis, includes M&I, Decertifications, and Recharge Projects (with & w/o Projected Excess Flow)

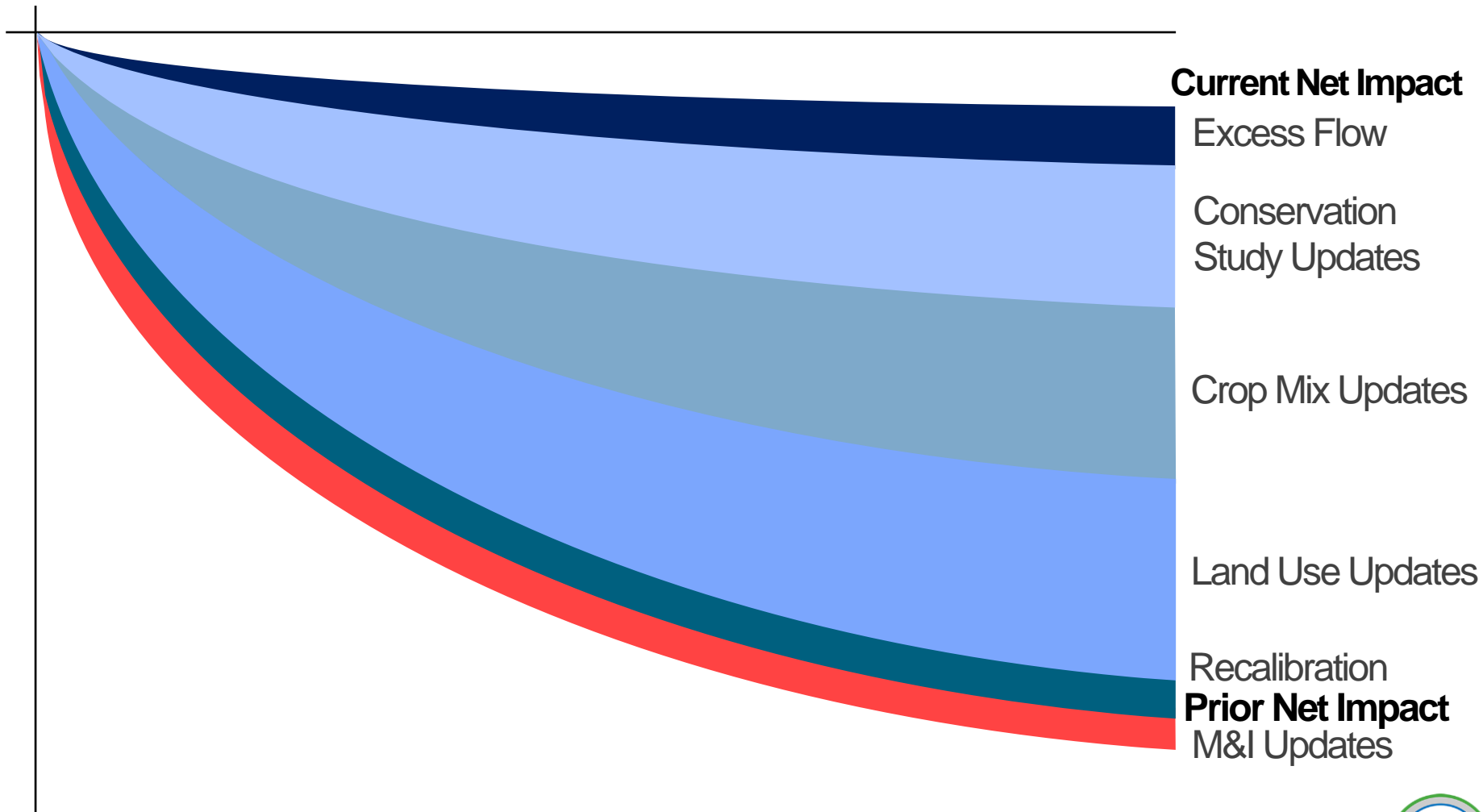


# TPNRD North Platte

Impact of Updates Relative to Prior Robust Review

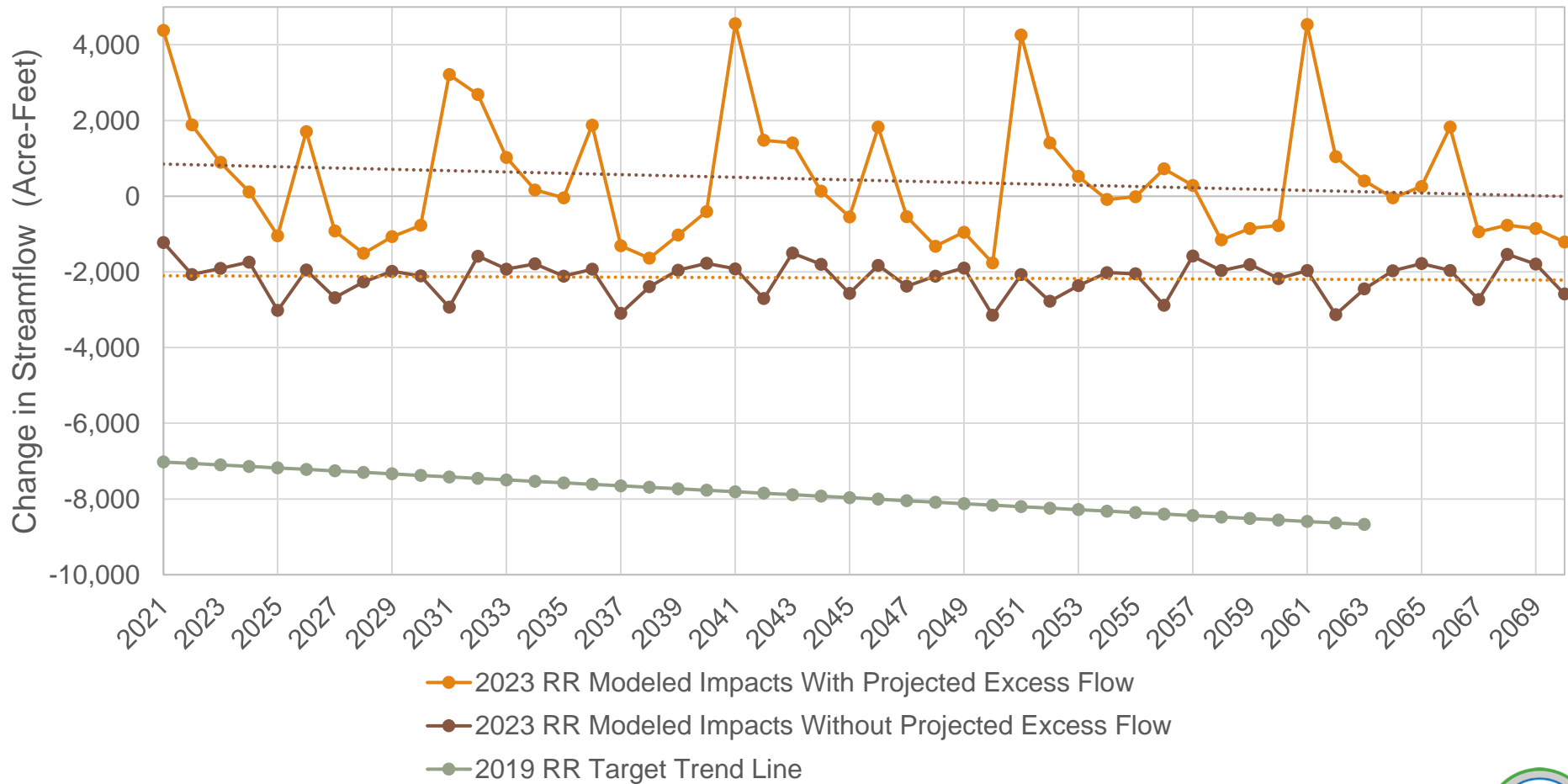
1997

2070



# TPNRD Results

## Target Comparison: North Platte River



# TPNRD Results

## Indicator\* Review: North Platte River

Year	Current IMP Targets (Indicator)	2023 Robust Review Results (Without Projected Excess Flow)	2023 Robust Review Results (With Projected Excess Flow)
2019	-6,900	-2,100	900
2020	-7,000	-2,100	900
2021	-7,000	-2,100	800
2022	-7,100	-2,100	800
<b><u>2023*</u></b>	<b><u>-7,100</u></b>	<b><u>-2,100</u></b>	<b><u>800</u></b>
2024	7,100	-2,100	800
2025	-7,200	-2,100	800
2026	-7,200	-2,100	800
2027	-7,300	-2,100	700
2028	-7,300	-2,100	700
2029	-7,300	-2,100	700

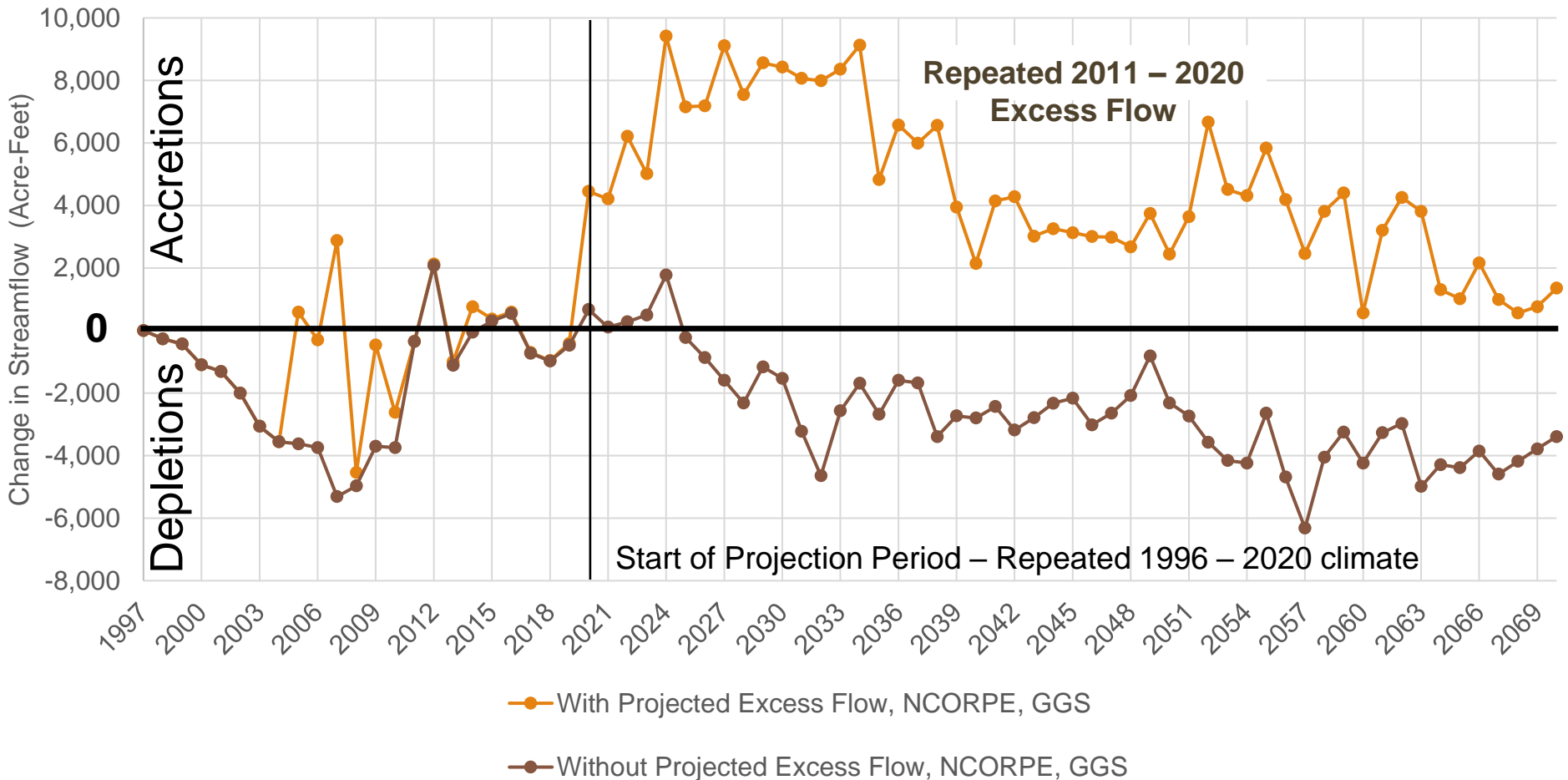


# South Platte River

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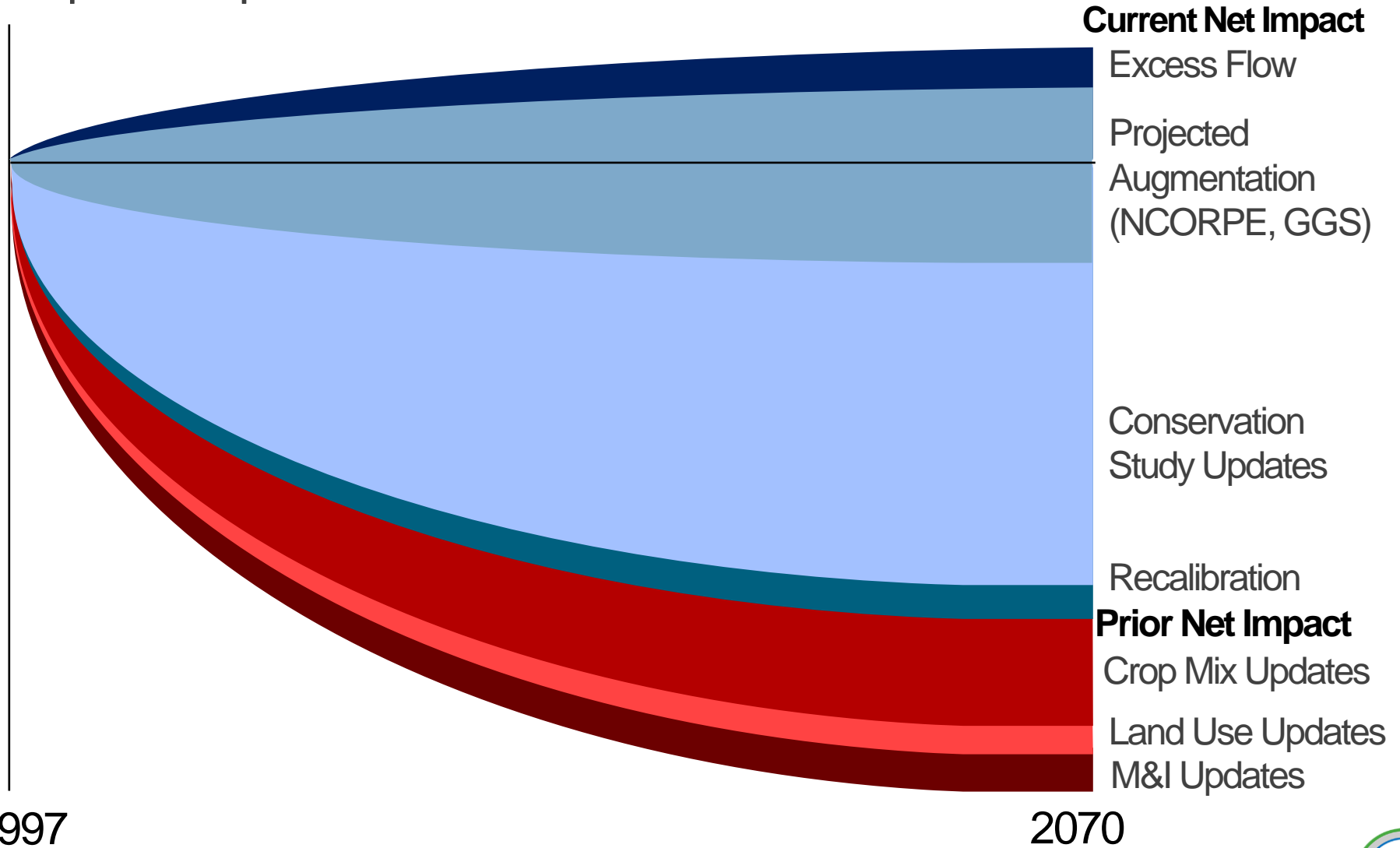
# TPNRD Results South Platte River

Robust Review Analysis Results: Post-1997 Analysis, includes M&I, Decertifications, Augmentation and Recharge Projects



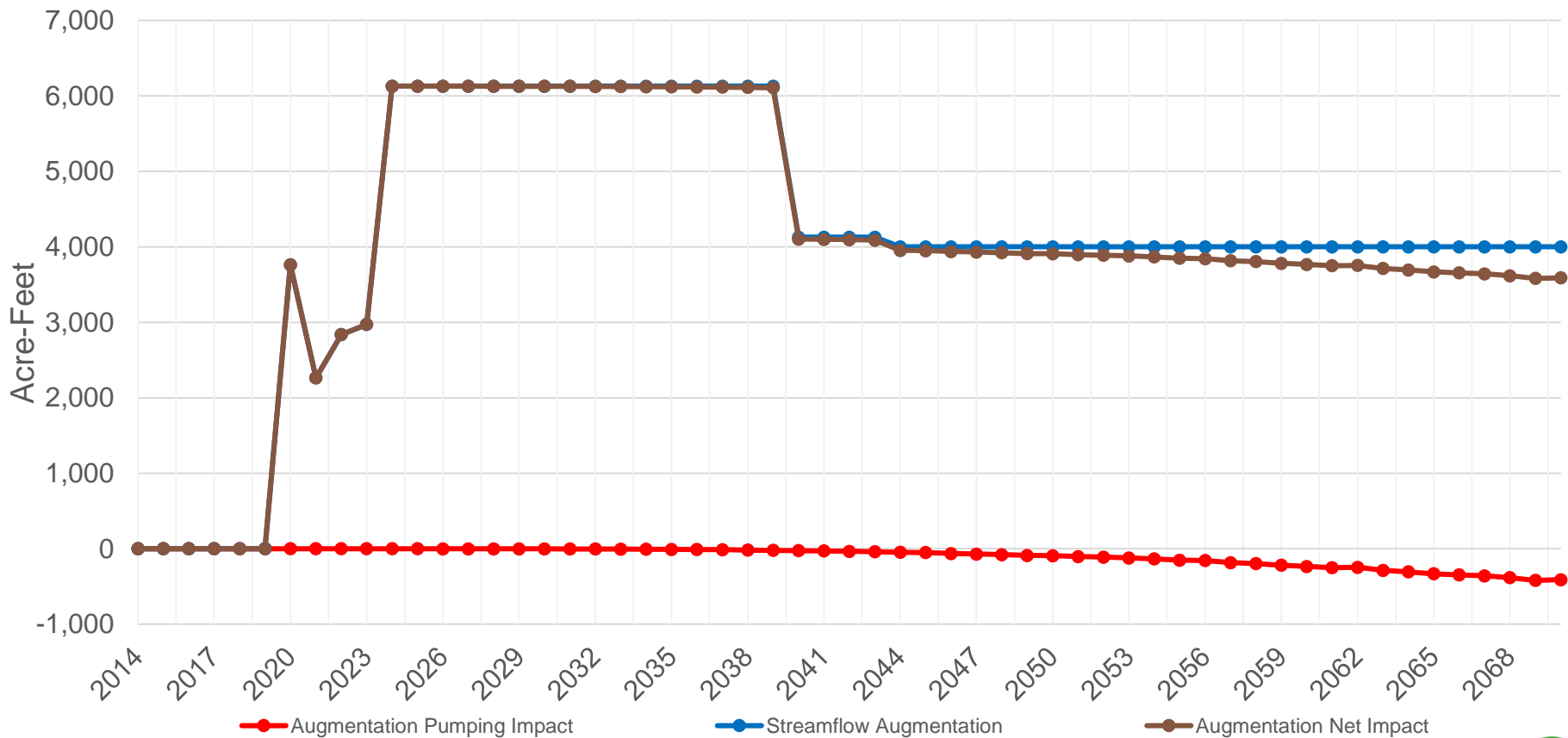
# TPNRD South Platte

## Impact of Updates Relative to Prior Robust Review



# TPNRD Results South Platte River – Management Actions

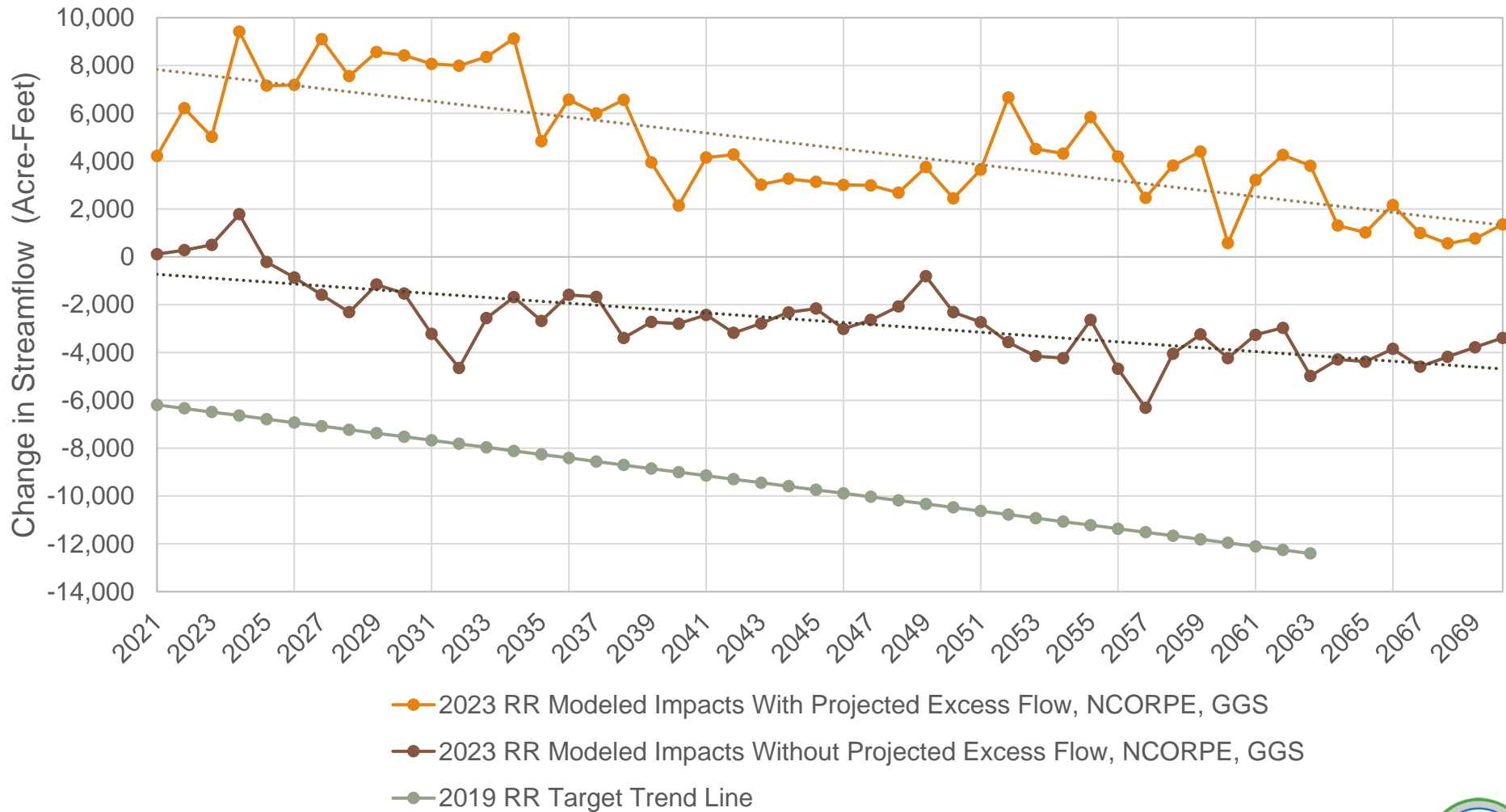
## Impacts from Augmentation South Platte





# TPNRD Results

## Target Comparison: South Platte River



# TPNRD Results

## Indicator\* Review: South Platte River

Year	Current IMP Targets (Indicator)	2023 Robust Review Results (Without Projected Excess Flow, NCORPE, GGS)	2023 Robust Review Results (With Projected Excess Flow, NCORPE, GGS)
2019	-5,900	-600	8,100
2020	-6,000	-600	8,000
2021	-6,200	-700	7,800
2022	-6,300	-800	7,700
<b><u>2023*</u></b>	<b><u>-6,500</u></b>	<b><u>-900</u></b>	<b><u>7,600</u></b>
2024	-6,600	-1,000	7,400
2025	-6,800	-1,100	7,300
2026	-6,900	-1,100	7,200
2027	-7,100	-1,200	7,000
2028	-7,200	-1,300	6,900
2029	-7,400	-1,400	6,800

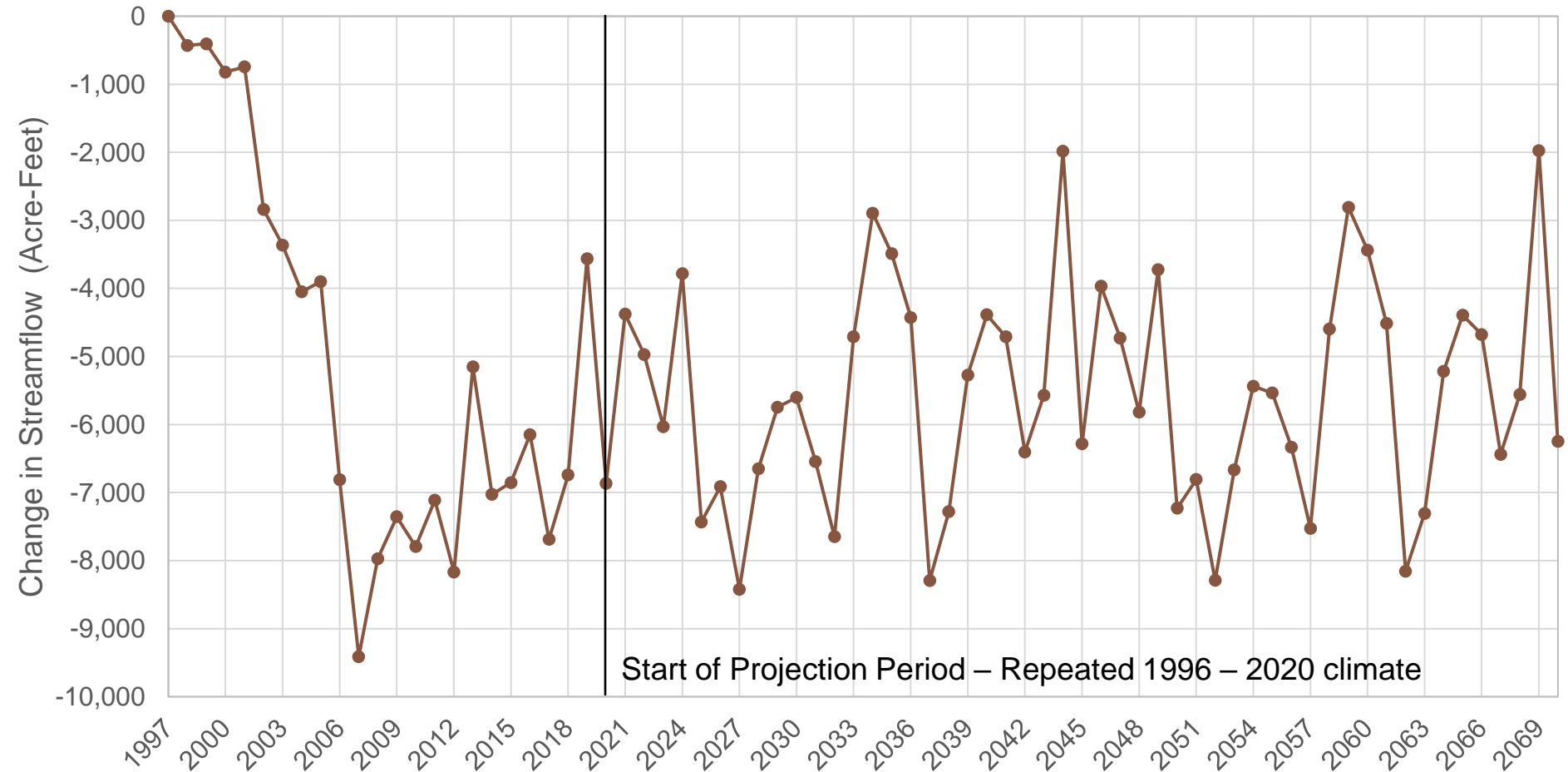


# Confluence to Elm Creek

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# TPNRD Results Confluence to Elm Creek

Robust Review Analysis Results: Post-1997 Analysis, includes M&I, Decertifications, and Recharge Projects

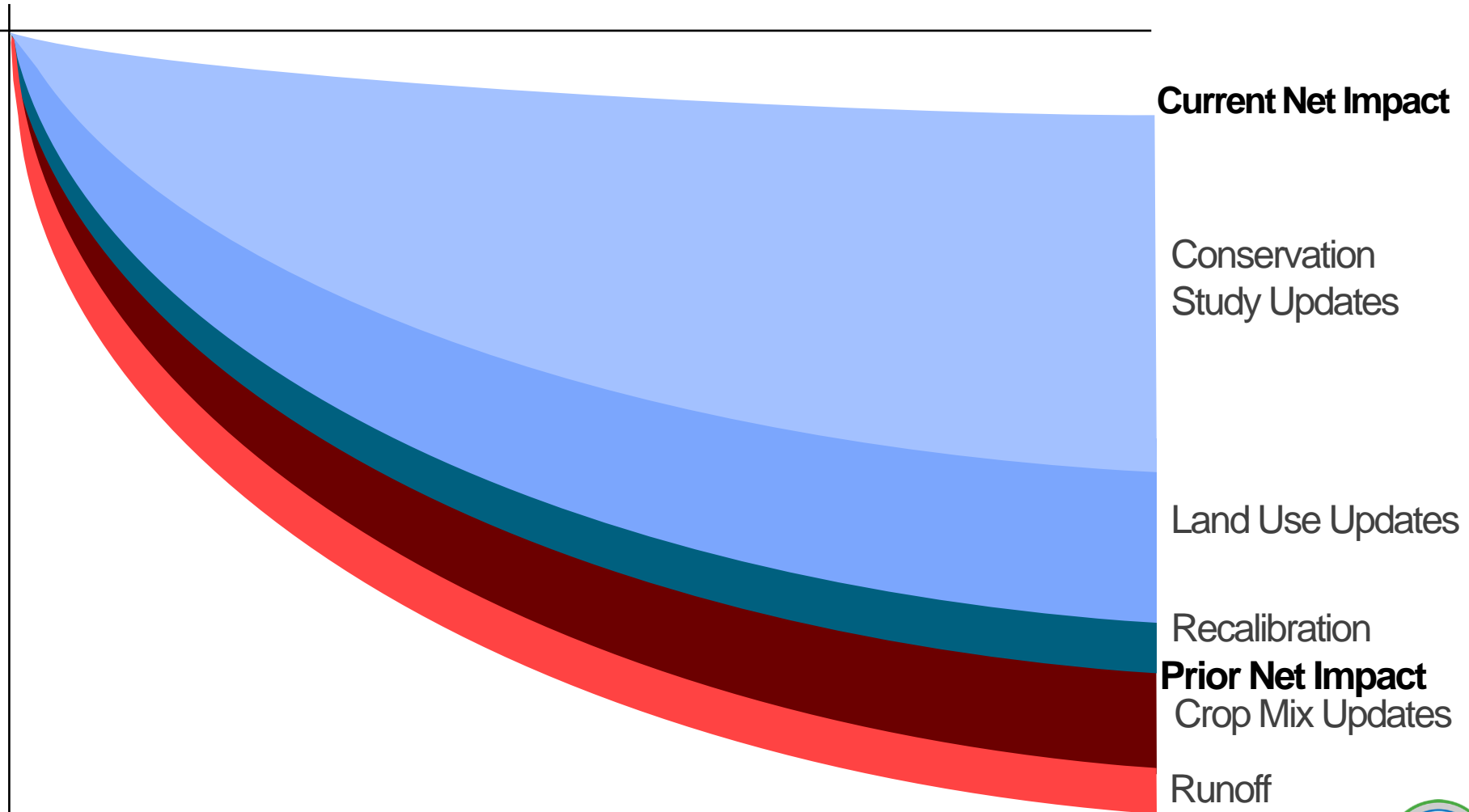


# TPNRD Confluence to Elm Creek

Impact of Updates Relative to Prior Robust Review

1997

2070



**Current Net Impact**

Conservation  
Study Updates

Land Use Updates

Recalibration

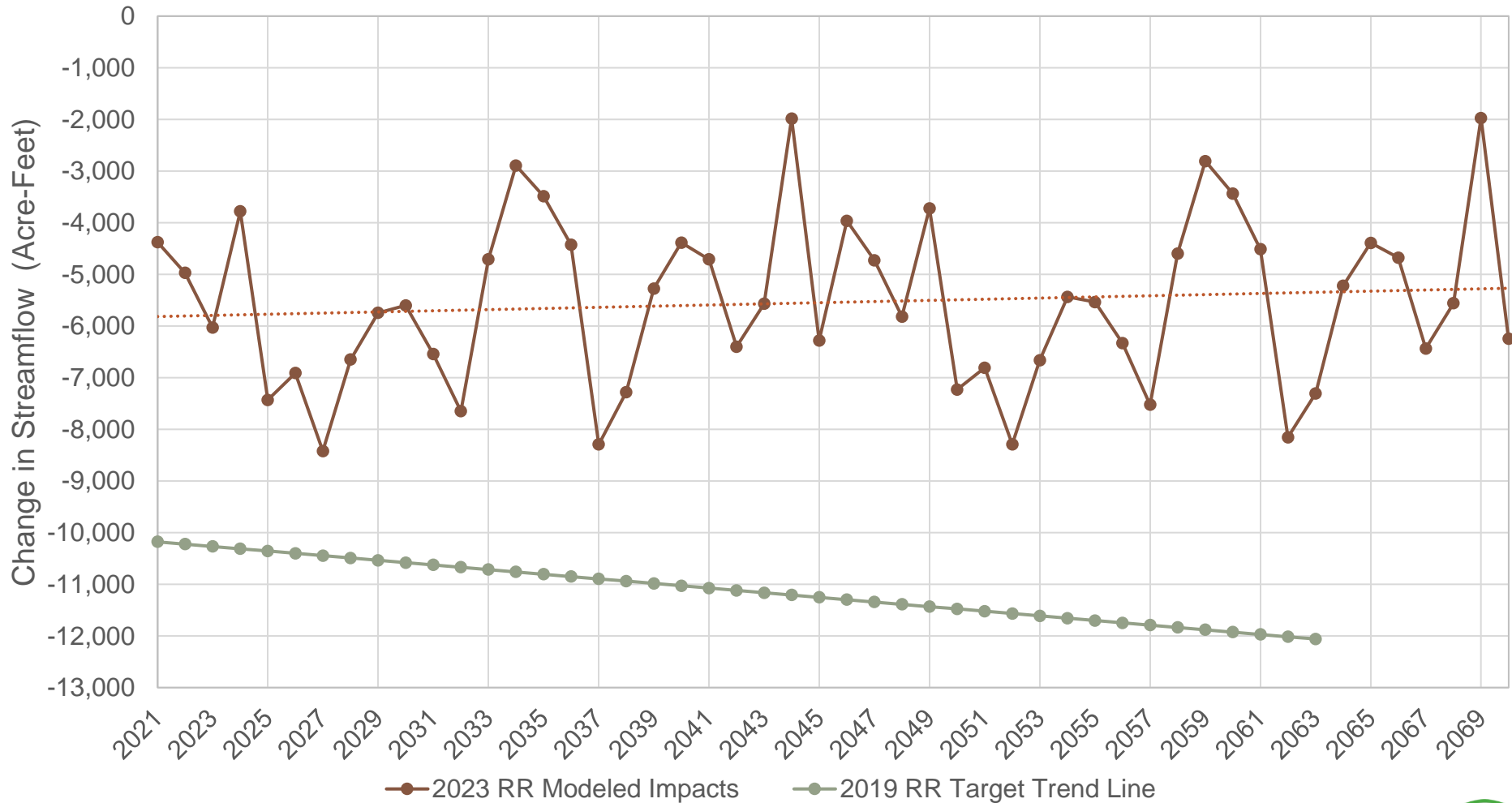
**Prior Net Impact**  
Crop Mix Updates

Runoff



# TPNRD Results

## Target Comparison: Confluence to Elm Creek



# TPNRD Results

## Indicator\* Review: Confluence to Elm Creek

Year	Current IMP Targets (Indicator)	2023 Robust Review Results
2019	-10,100	-5,800
2020	-10,100	-5,800
2021	-10,200	-5,800
2022	-10,200	-5,800
<b><u>2023*</u></b>	<b><u>-10,300</u></b>	<b><u>-5,800</u></b>
2024	-10,300	-5,800
2025	-10,400	-5,800
2026	-10,400	-5,800
2027	-10,400	-5,800
2028	-10,500	-5,700
2029	-10,500	-5,700



# TPNRD Results

## Indicator\* Review: Reaches in TPNRD

Year	Confluence to Elm Creek Current IMP Targets	South Platte River Current IMP Targets	North Platte Current IMP Targets	Total NRD IMP Targets	Total NRD Robust Review Results With Projections	Total NRD Results Without Projections
2019	-10,100	-5,900	-6,900	-22,900	3,200	-8,500
2020	-10,100	-6,000	-7,000	-23,100	3,100	-8,500
2021	-10,200	-6,200	-7,000	-23,400	2,800	-8,600
2022	-10,200	-6,300	-7,100	-23,600	2,700	-8,700
<b>2023*</b>	<b>-10,300</b>	<b>-6,500</b>	<b>-7,100</b>	<b>-23,900</b>	<b>2,600</b>	<b>-8,800</b>
2024	-10,300	-6,600	7,100	-24,000	2,400	-8,900
2025	-10,400	-6,800	-7,200	-24,400	2,300	-9,000
2026	-10,400	-6,900	-7,200	-24,500	2,200	-9,000
2027	-10,400	-7,100	-7,300	-24,800	1,900	-9,100
2028	-10,500	-7,200	-7,300	-25,000	1,900	-9,100
2029	-10,500	-7,400	-7,300	-25,200	1,800	-9,200





# IMP Target Summary

- **North Platte River:**
  - Post-1997 level of development reached with ongoing excess flow diversions
  - Maintain current management actions
  - No regulatory action required – if excess flows continue at projected rate
- **South Platte River:**
  - Post-1997 level of development reached with ongoing excess flow diversions and augmentation
  - Maintain current management actions
  - No regulatory action required
- **Below Confluence:**
  - Post-1997 level of development likely reached with ongoing excess flow diversions and augmentation upstream
  - Maintain current management actions
  - May require closer evaluation of timing and location of depletions



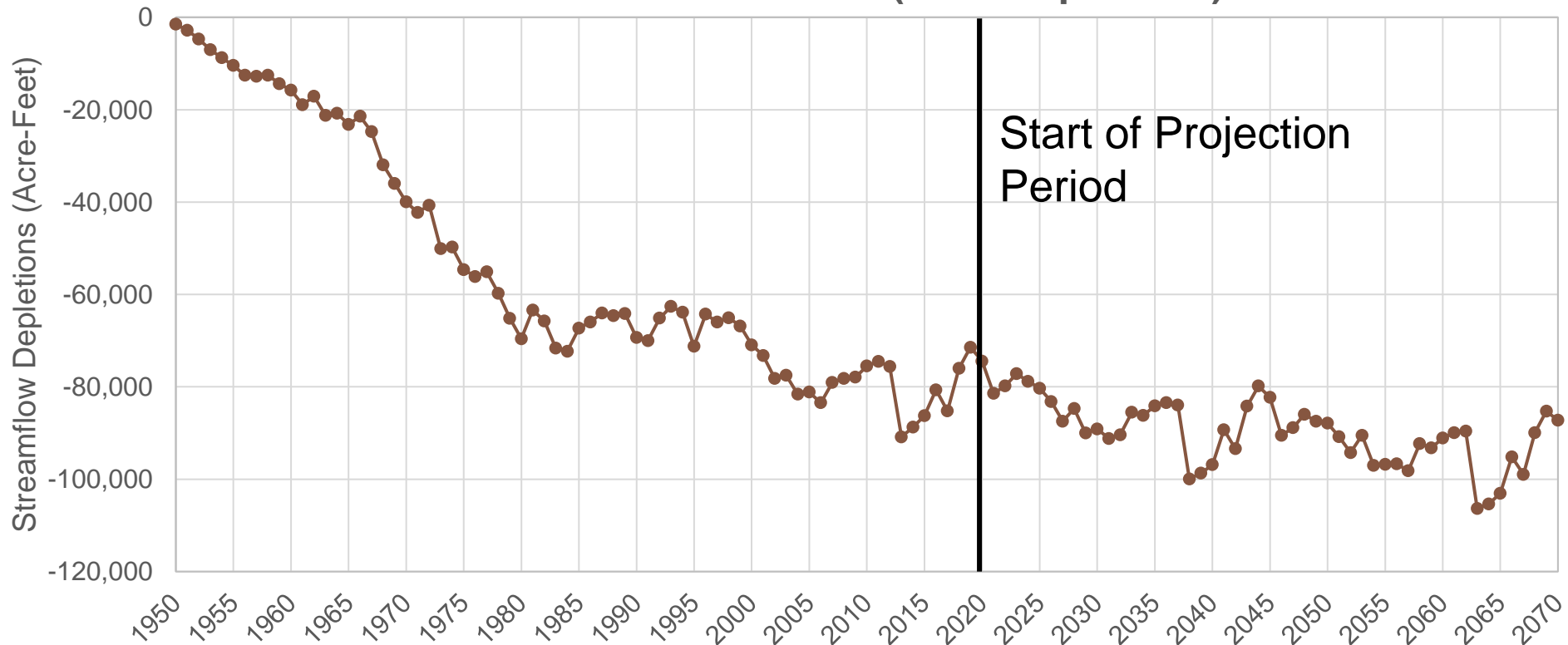
# Total Depletions Results

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# TPNRD Results – Total Depletions

Impacts from all Groundwater Only and M&I Pumping

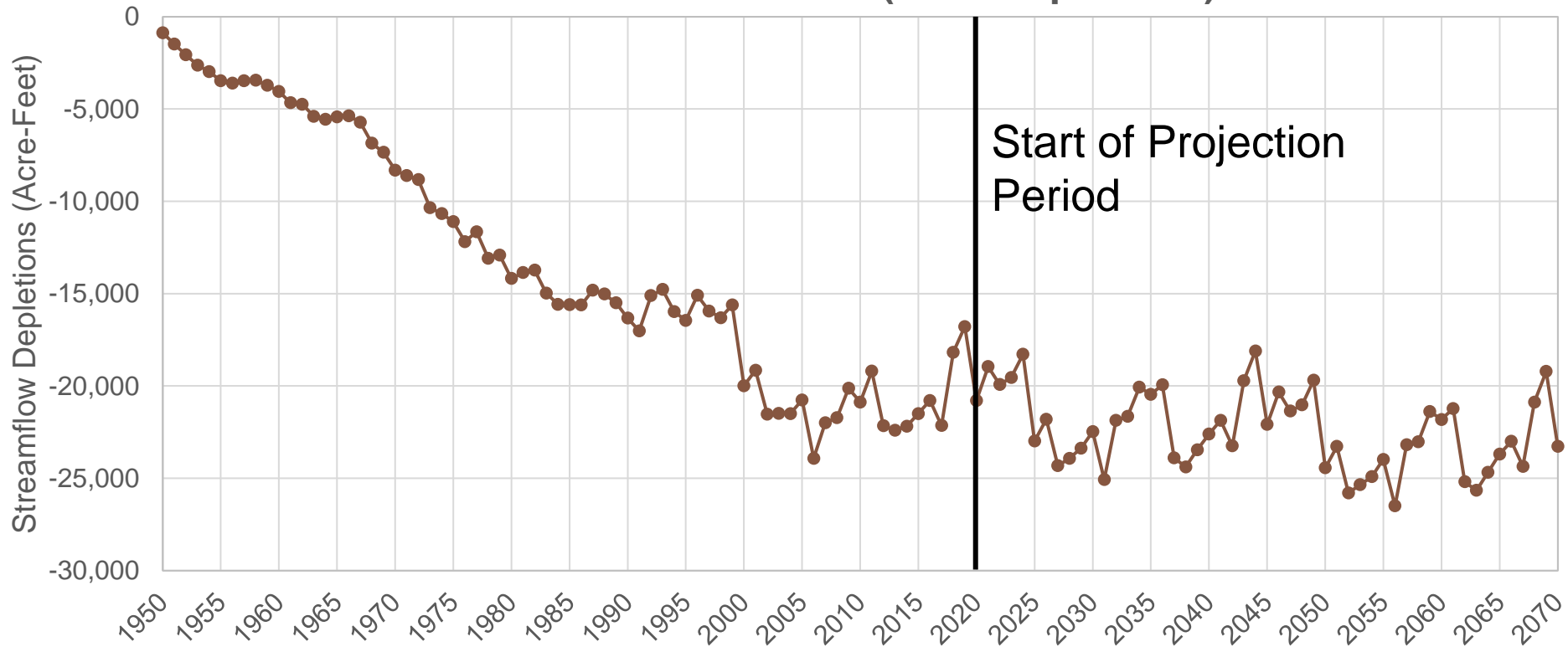
**TPNRD: South Platte River (Total Depletions)**



# TPNRD Results – Total Depletions

Impacts from all Groundwater Only and M&I Pumping

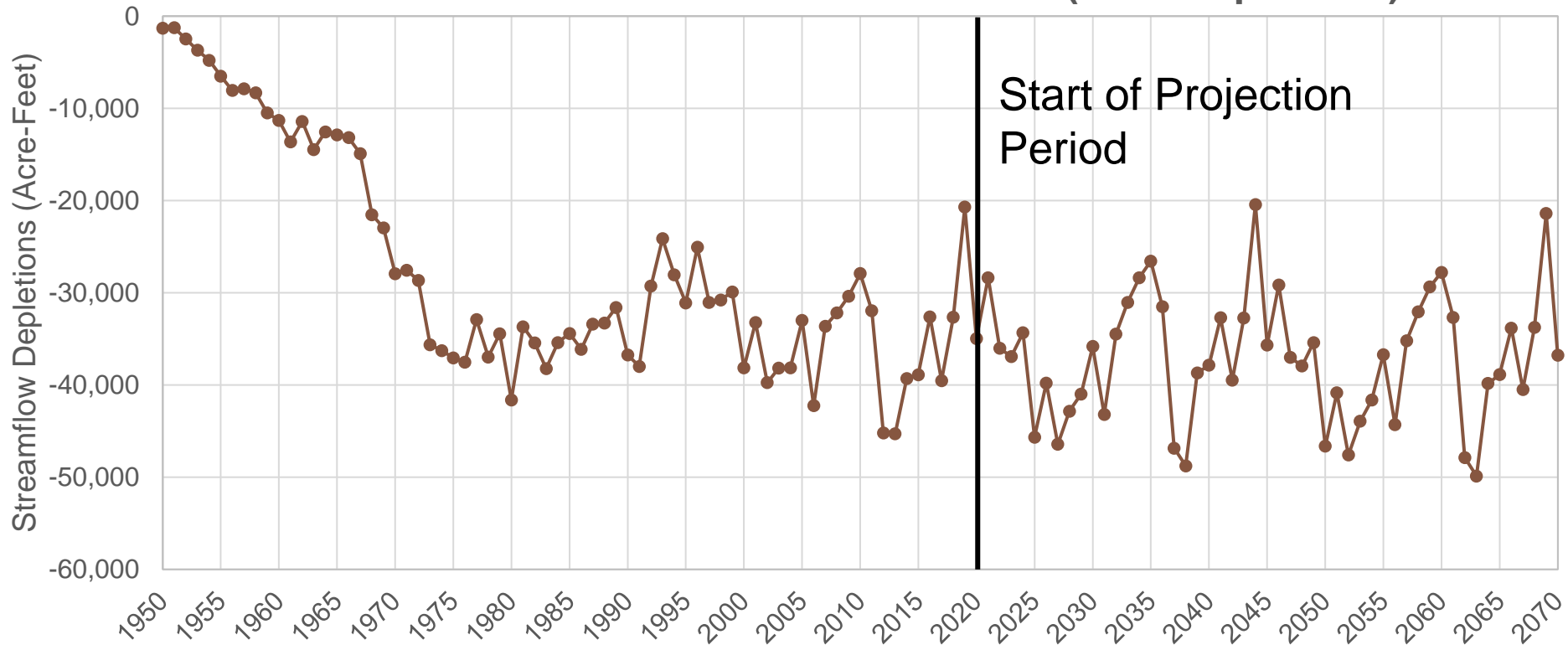
TPNRD: North Platte River (Total Depletions)



# TPNRD Results – Total Depletions

Impacts from all Groundwater Only and M&I Pumping

**TPNRD: Platte River Confluence to Elm Creek (Total Depletions)**



# Path Forward

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# Path Forward / Next Steps

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- Finish Documentation of Models and Analyses
- Present update during May PRRIP meeting
- Present Results during August 1<sup>st</sup> BWP Stakeholder meeting
- IMP Update
- Continue Management Actions
  - Excess flows – approx. 4,300 af/yr in 2011 – 2020
  - Increased & increasing number of projects since 2020
- Prepare for 2027 Robust Review in this Increment
  - Update input data for models
  - Incorporate TPNRD Water Program data
- Develop Basin-Wide and NRD drought plans
  - UPRDCP to be in place by end of 2024
- Changes to Municipal and Industrial offset requirements in 2026





NEBRASKA

Good Life. Great Water.

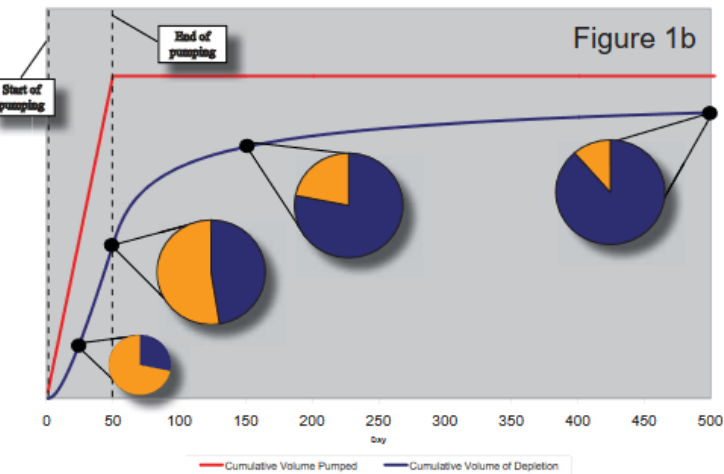
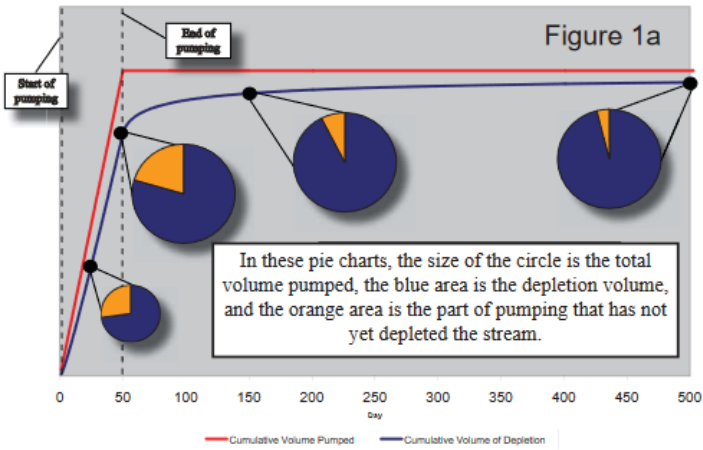
DEPT. OF NATURAL RESOURCES

THANK YOU

Jesse Bradley, NeDNR



# Lagged Depletions Effects



## Explanation of Pie Charts in Figures 1a, 1b, and 1c

1

2

3

The pie charts in figures 1a, 1b, and 1c show the amount of streamflow depletion relative to the volume of water pumped. Here, pie chart 1 represents the height of the red line, which is the entire amount pumped. Pie chart 2 represents the height of the blue line, which is only the depletion due to groundwater pumping at day 500 in figure 1c. Note that the pie chart is incomplete: there is a portion of the full pie (which represents the volume of water pumped) that is missing. Pie chart 3 is that missing piece. The orange area represents the difference between pie charts 1 and 2, which is the distance between the red and blue lines. This is portion of the groundwater pumping that has not yet been realized as a depletion.

