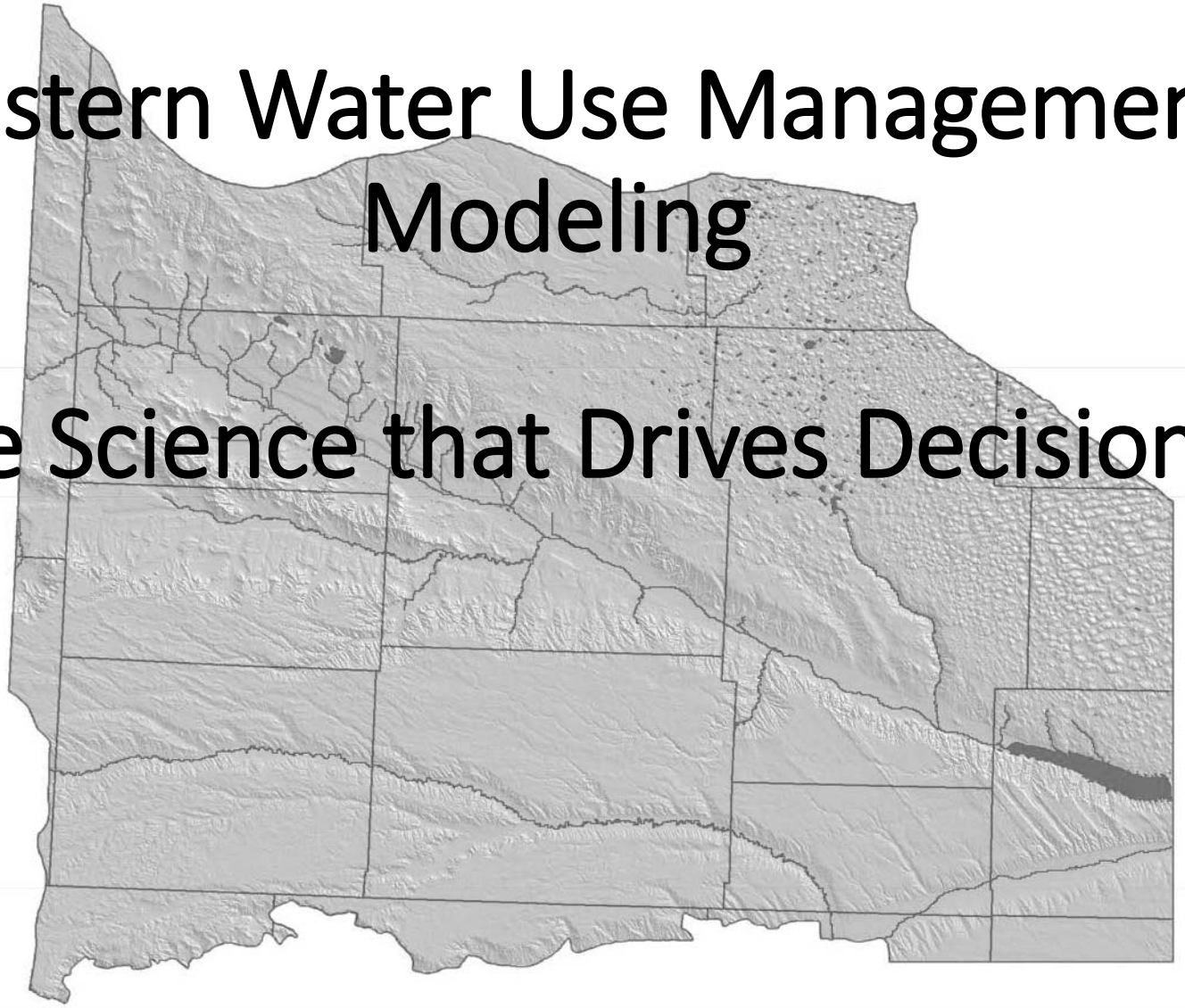
# Western Water Use Management Modeling

## The Science that Drives Decisions



NORTH PLATTE
Natural Resources District

# The Western Water Use Management Model(WWUMM) is the most important tool that NPNRD uses to make management decisions by determining whether we are at a deficit level of irrigation

- Almost exclusively based on collection of actual land use data (from aerial imagery and field level inspections)
- collection of pumping data
- climate data

WWUMM is used to determine whether an incentive-based program will be advantageous to meeting our goals and obligations under the Integrated Management Plan

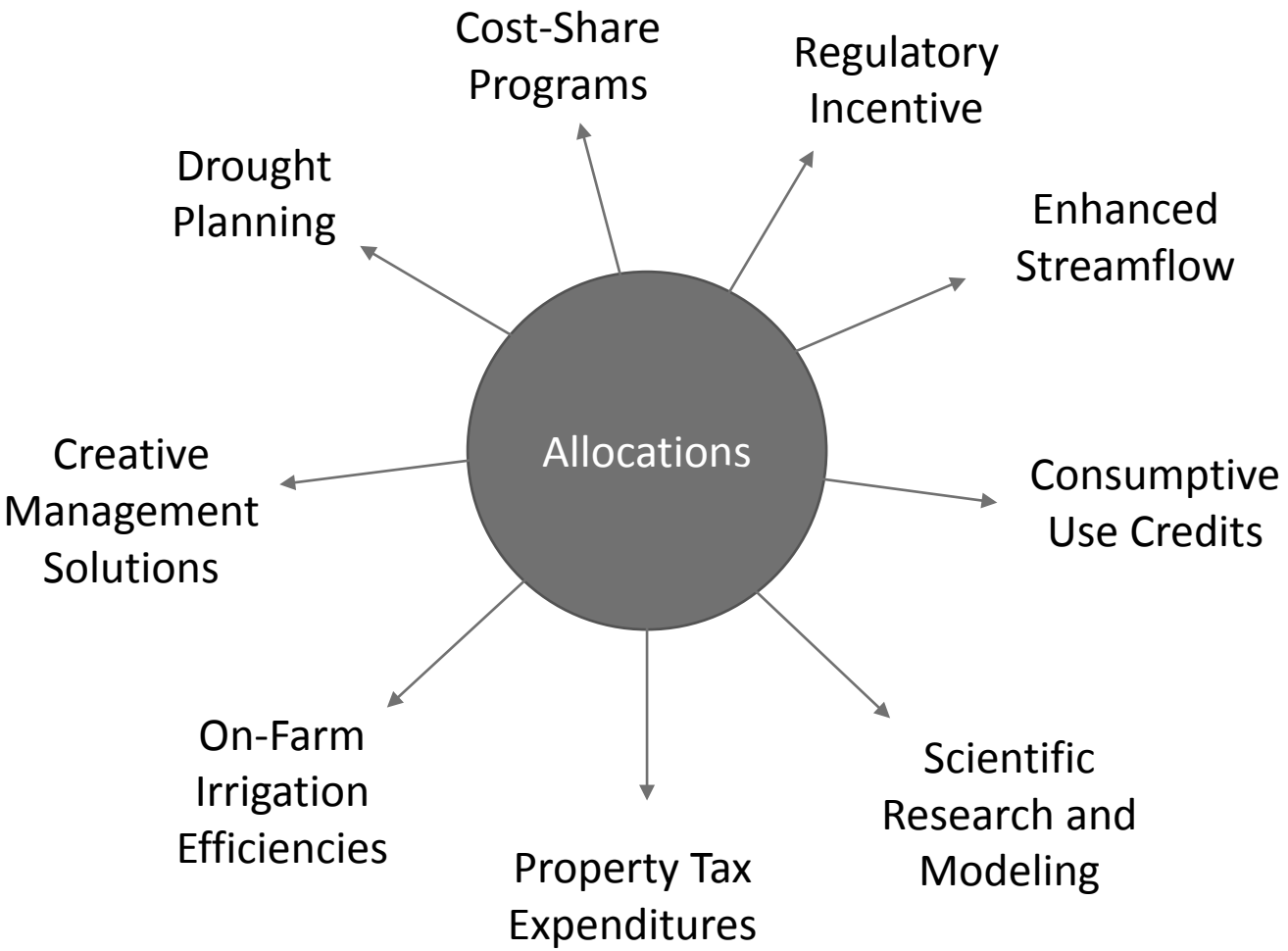
- Leases
- Retirements
- Recharge Facilities
- Allocation Buy Downs
- Cost-share investments

# Allocations

Allocations are far and away the most beneficial to meeting our goals, and have, arguably, made agriculture in this District more efficient, and thereby more profitable through the reduction of pumping costs.

This more efficient application of water including more efficient timing of irrigation has also improved yields.

# Allocations – The Hub of NPNRD Regulations



# First IMP Increment Allocation Design

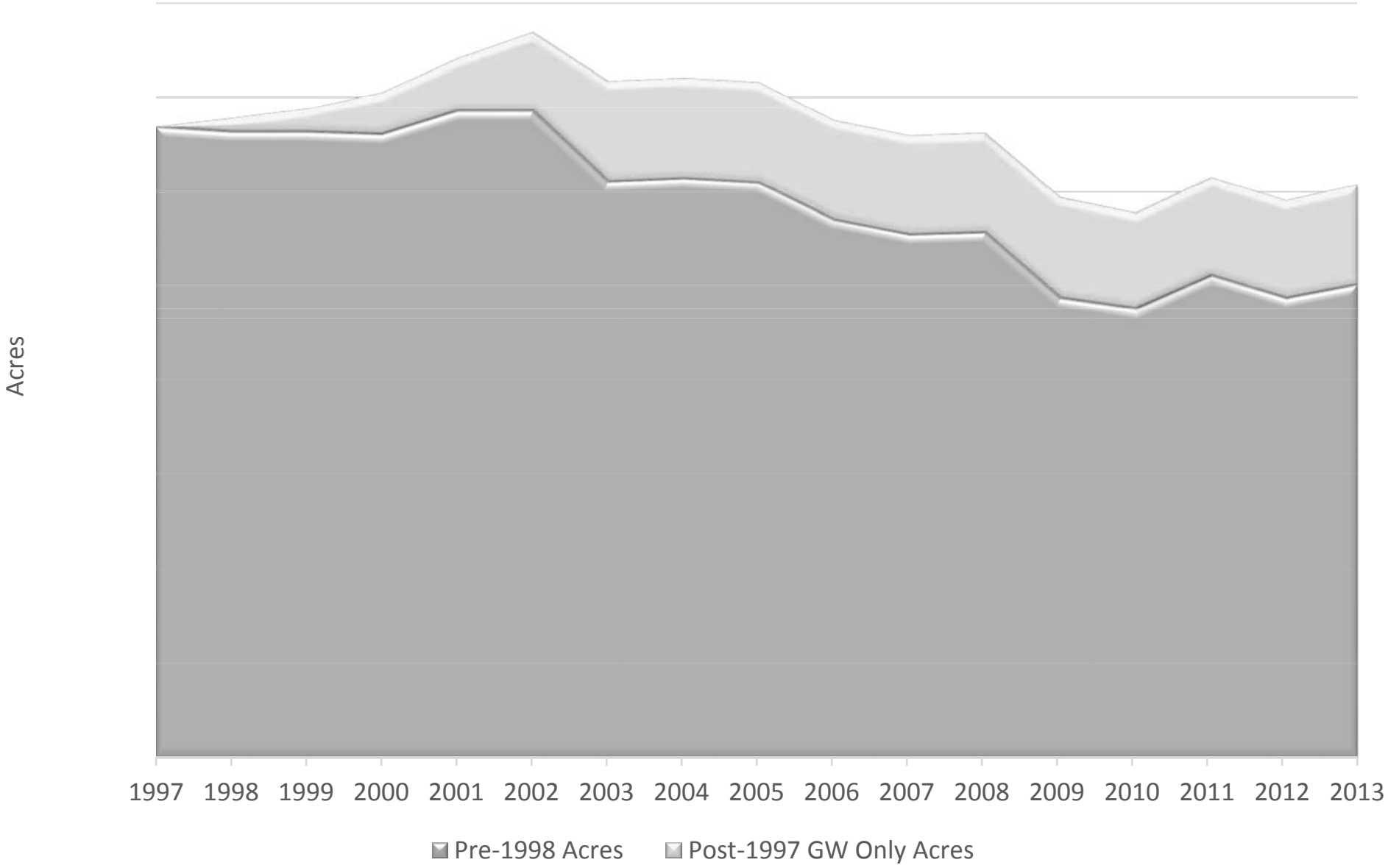
- 2008 COHYST Analyses
  - Established that NPNRD had 8,000 Acre-Feet of Post-1997 Depletions
  - Determined overall NPNRD crop mix net irrigation requirement (NIR) or irrigation consumptive use
    - 15 Acre-Inches / Acre
  - Post-1997 Depletions Mitigation
    - Place a 14 Acre-Inch / Acre pumping limit on all ground water irrigated lands
    - Goal to reduce crop consumptive use by 1 Acre-Inch / Acre
    - Estimated to make up the 8,000 acre-feet per acre
  - Management Style Unique in Platte Basin

# Beyond COHYST

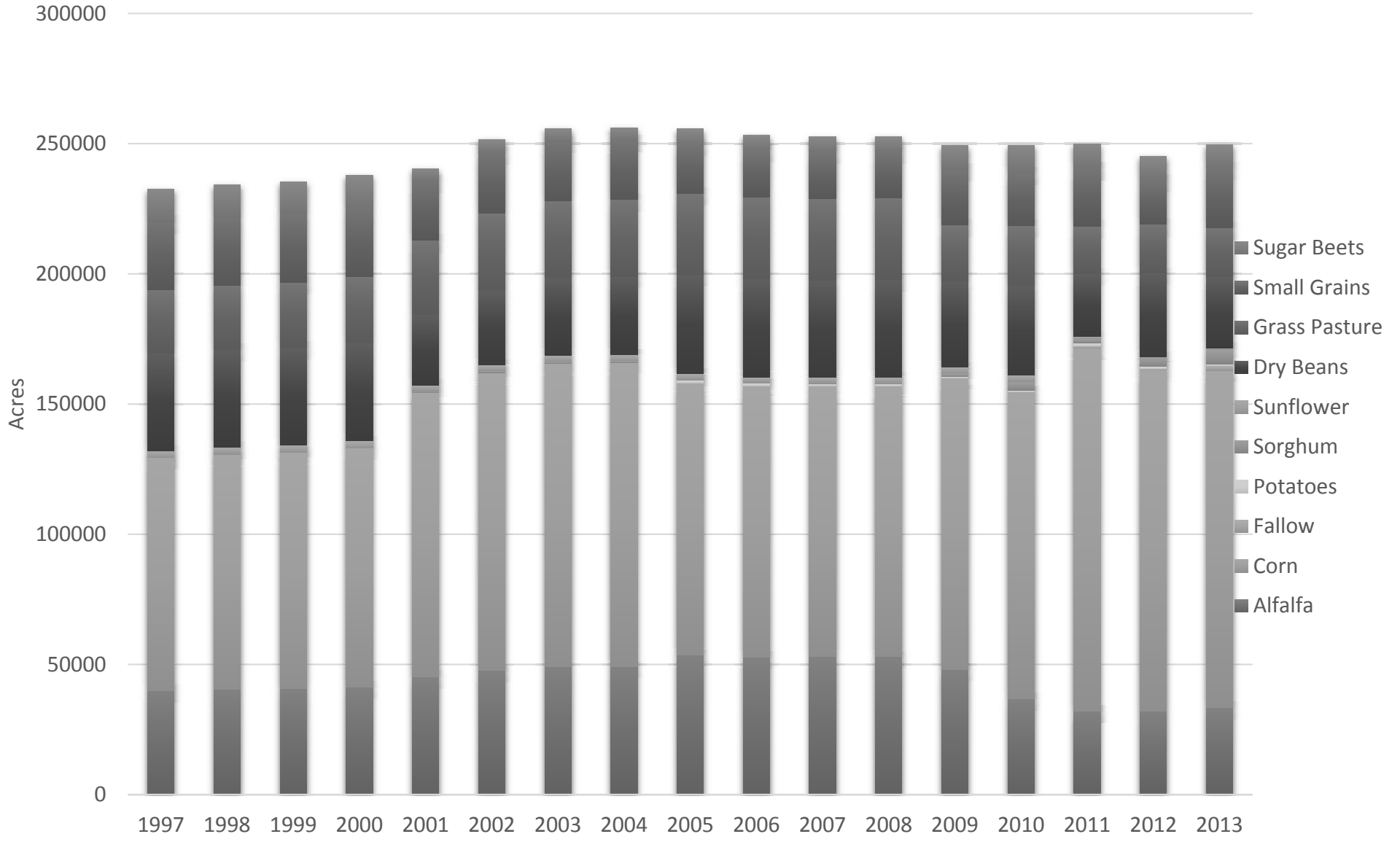
- Enter **Western Water Use Management Modeling**
  - Highly data driven modeling
  - Extensive land use dataset with multiple data sources creating a robust understanding of water use
  - Integration of the metered data into modeling
    - Unique in Platte Basin
  - Used as a decision support tool for NPNRD and DNR

# Land Use Dataset Information

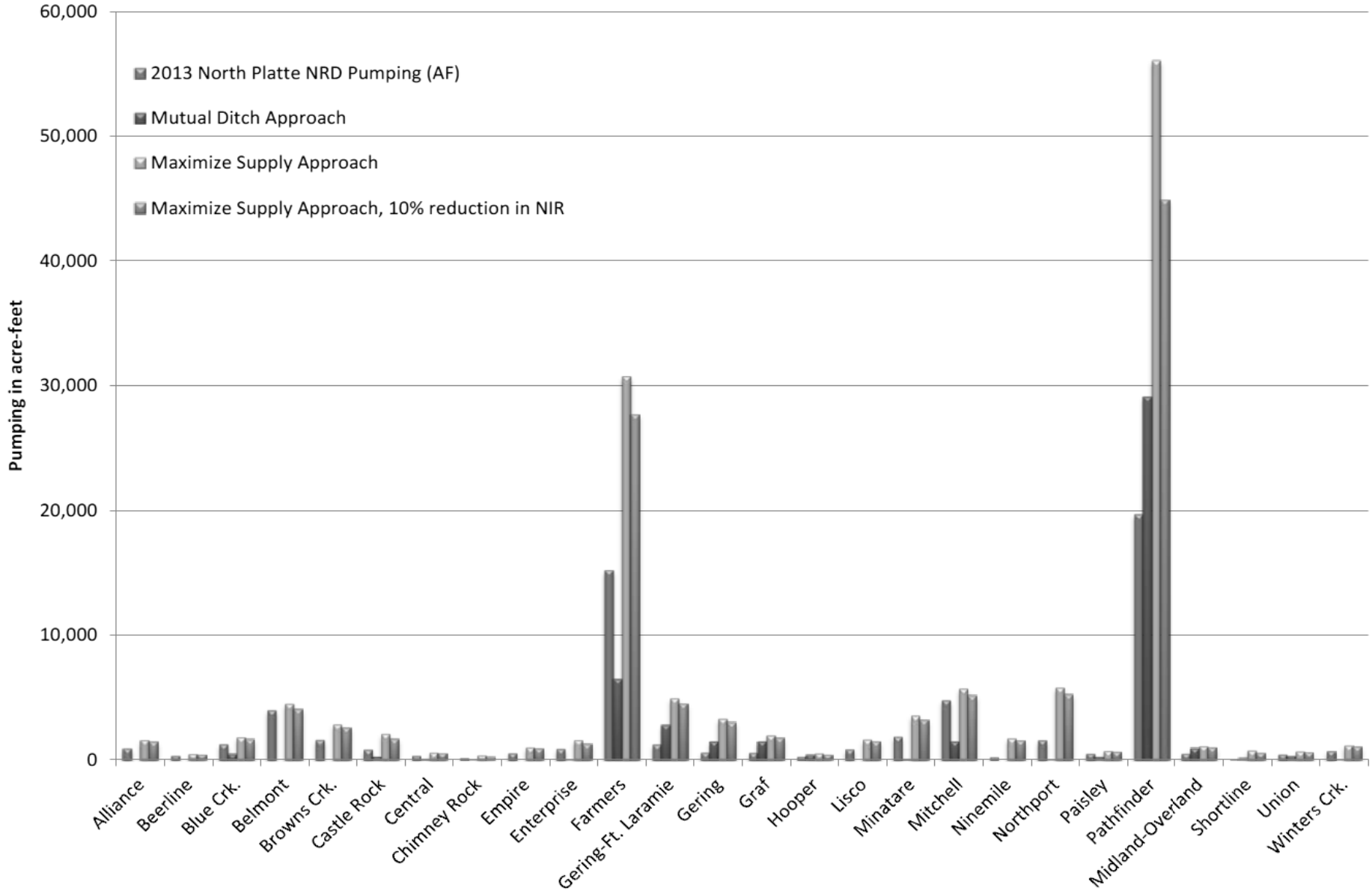
# NPNRD All Active Ground Water Only Land Use Development in OA Area



# NPNRD Annual Crop Statistics from 1997 through 2013



# Comingled Pumping Information (2013)



# Change Modeling Discussion

# Change Modeling Discussion

- Modeling Design
  - Baseline Model
    - Typically the historic model with everything that actually happened
  - Modified Model
    - Modify one feature of the model
    - Example: Remove irrigated lands from the model to determine the depletive affects
  - Analysis
    - Baseline Model – Modified Model = Change
    - Change is typically streamflow or baseflow

# Unit Response Functions

# Unit Response Functions

- Determine accretive impacts from retiring ground water irrigated acres, similar to depletion zone in the COHYST model

- Used for Evaluation of Incentive Based Programs (EPIC)

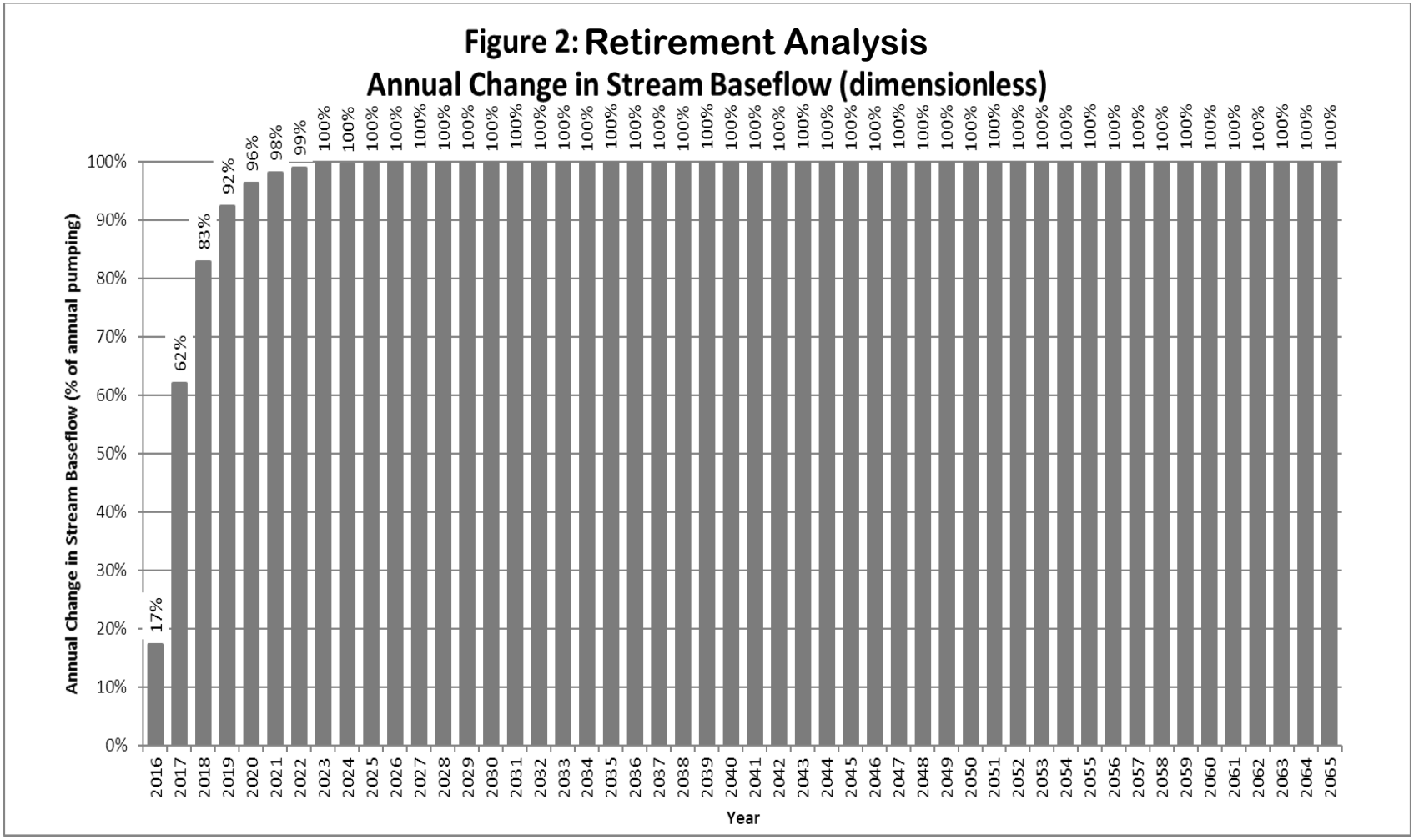


Figure 2: Retirement Analysis
Annual Change in Stream Baseflow (dimensionless)
Annual Change in Stream Baseflow (% of annual pumping)
Year
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
17%
62%
83%
92%
96%
98%
99%
100%
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# Allocation Analysis

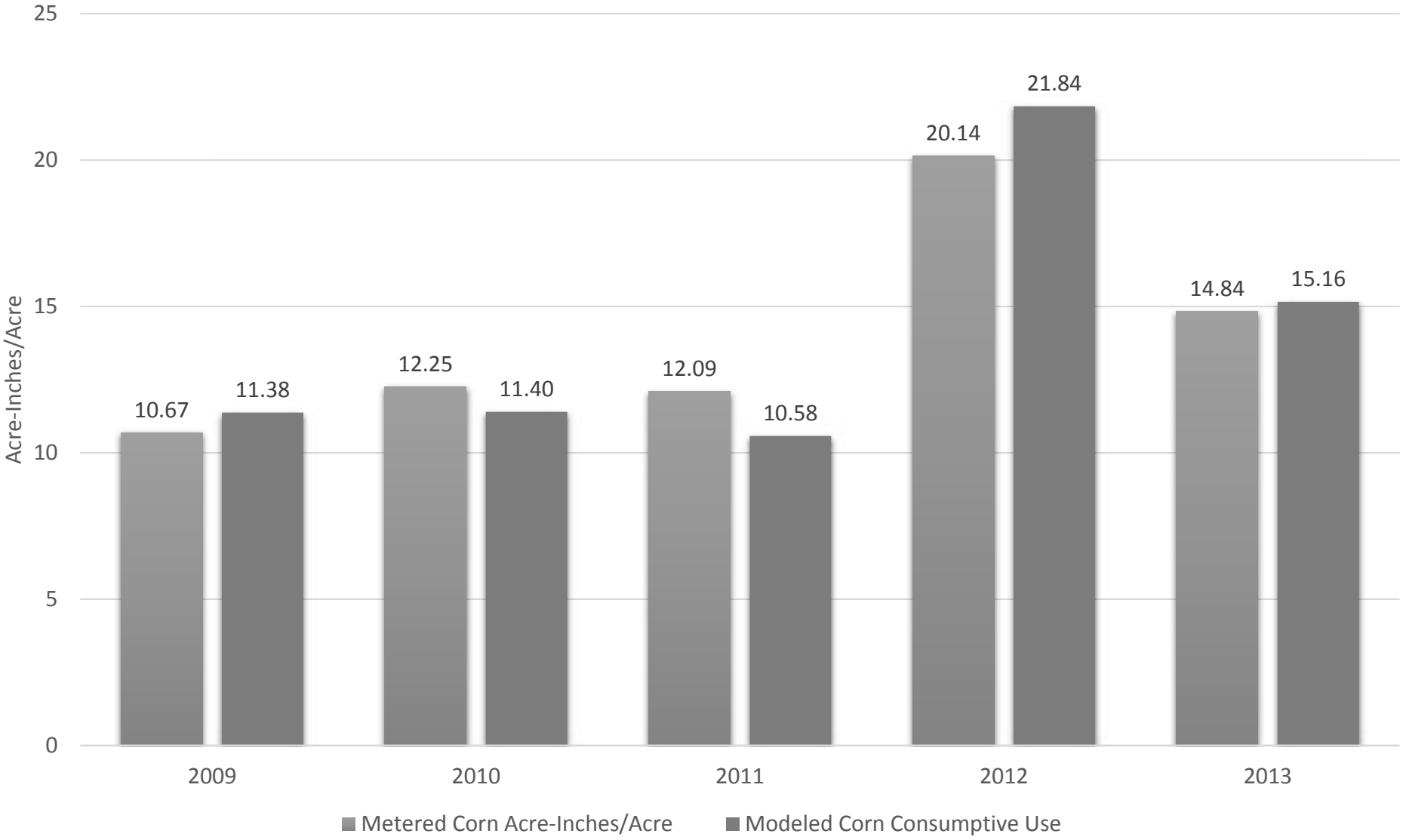
# Allocation Analysis

- Generalized Concept
  - Determine the effectiveness of NPNRD's allocations at reducing consumptive use and depletions
  - Comparison of:
    - Metered Pumping from NPNRD
      - Actual pumping at each farm
    - Modeled Pumping created through WWUM Modeling
      - Pumping at the full consumptive use of the crops for the ground water only lands
    - **IMPORTANT** We assumed no benefit from allocations on commingled lands due to dual sources of water

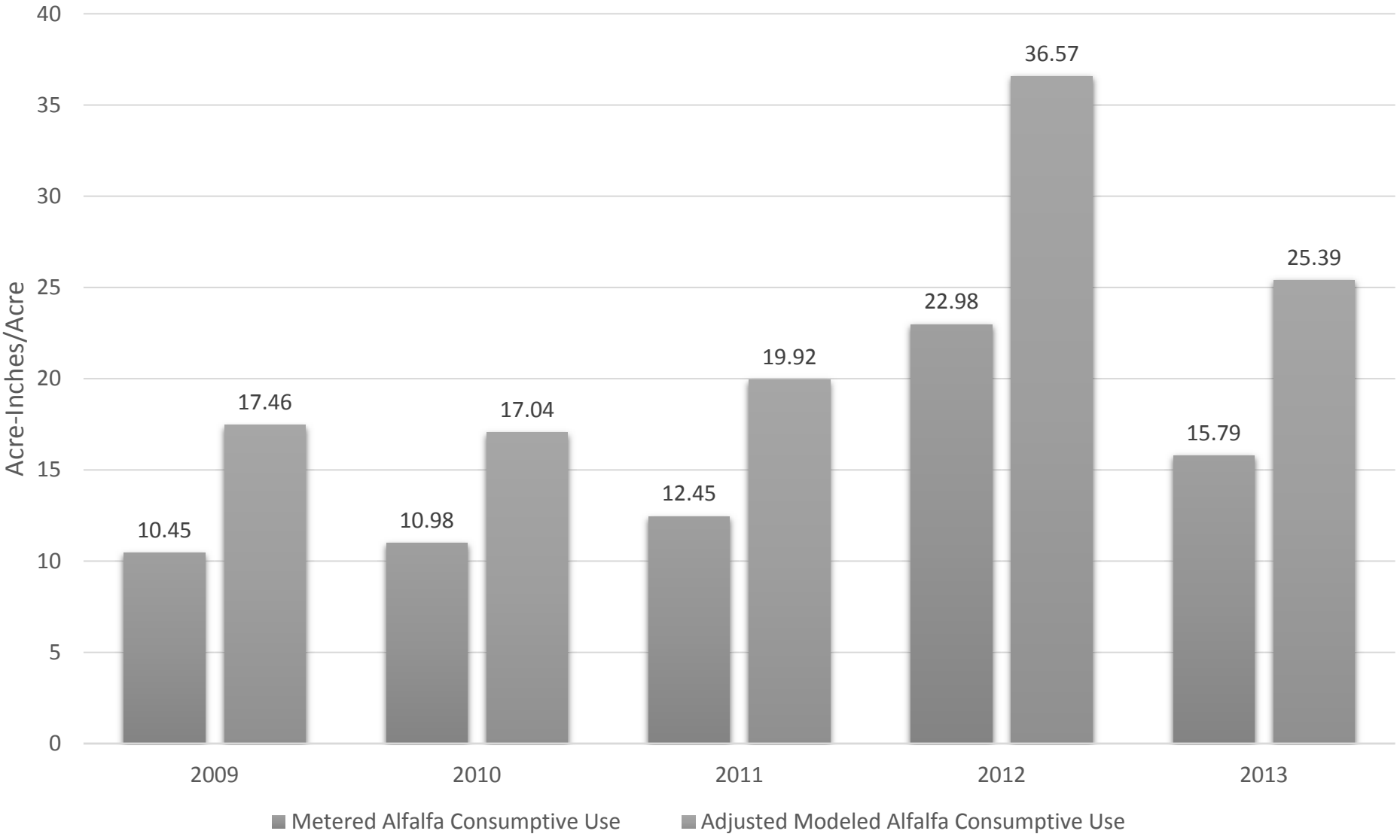
# Allocation Analysis

- Generalized Concept
  - Comparison (cont.):
    - Completed by comparing two ground water model runs
  - Repeat recharge and pumping from 2009 through 2013 for 50 years into the future to provide a planning information for the District

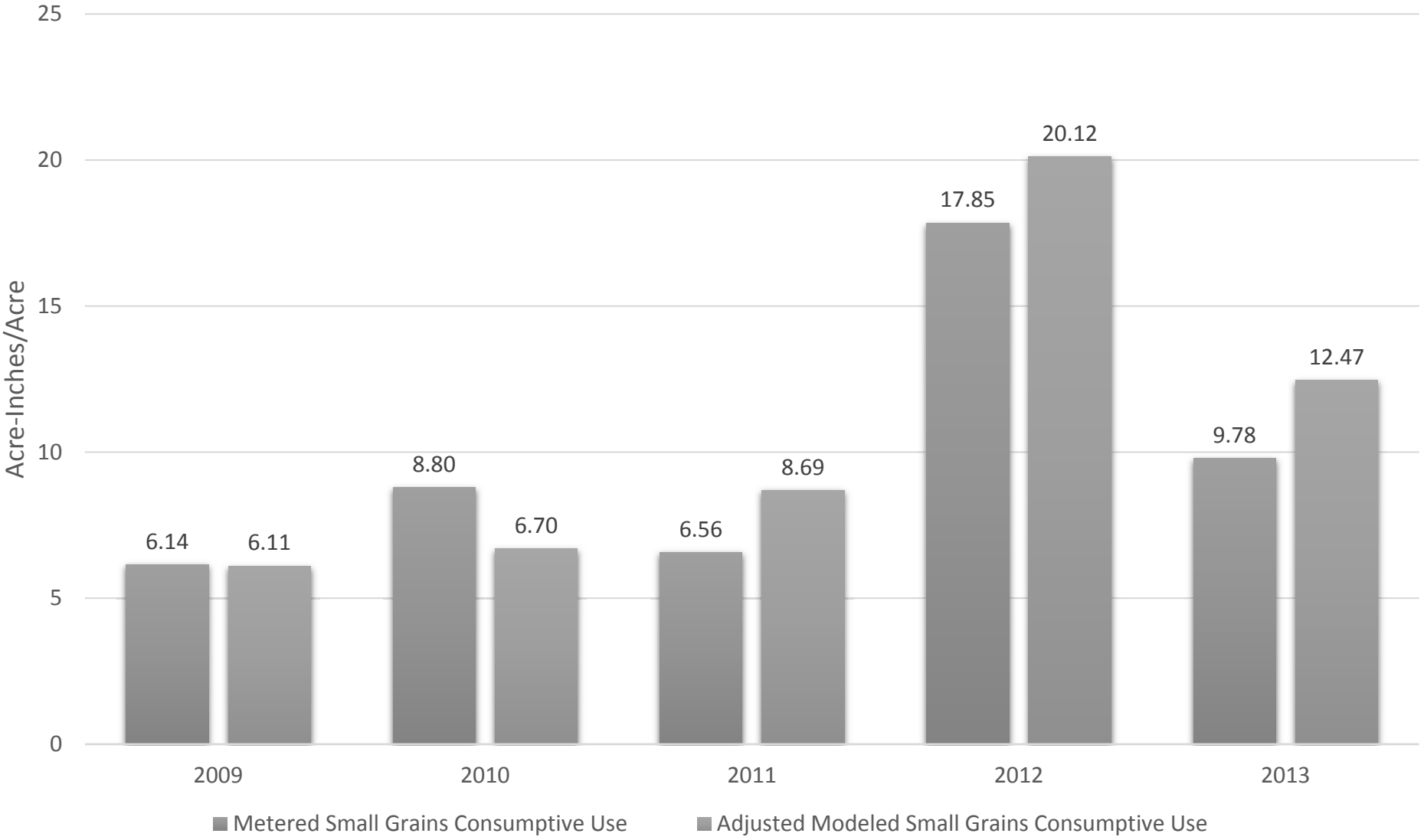
# NPNRD Corn Only Lands
# Metered CU vs. Modeled CU



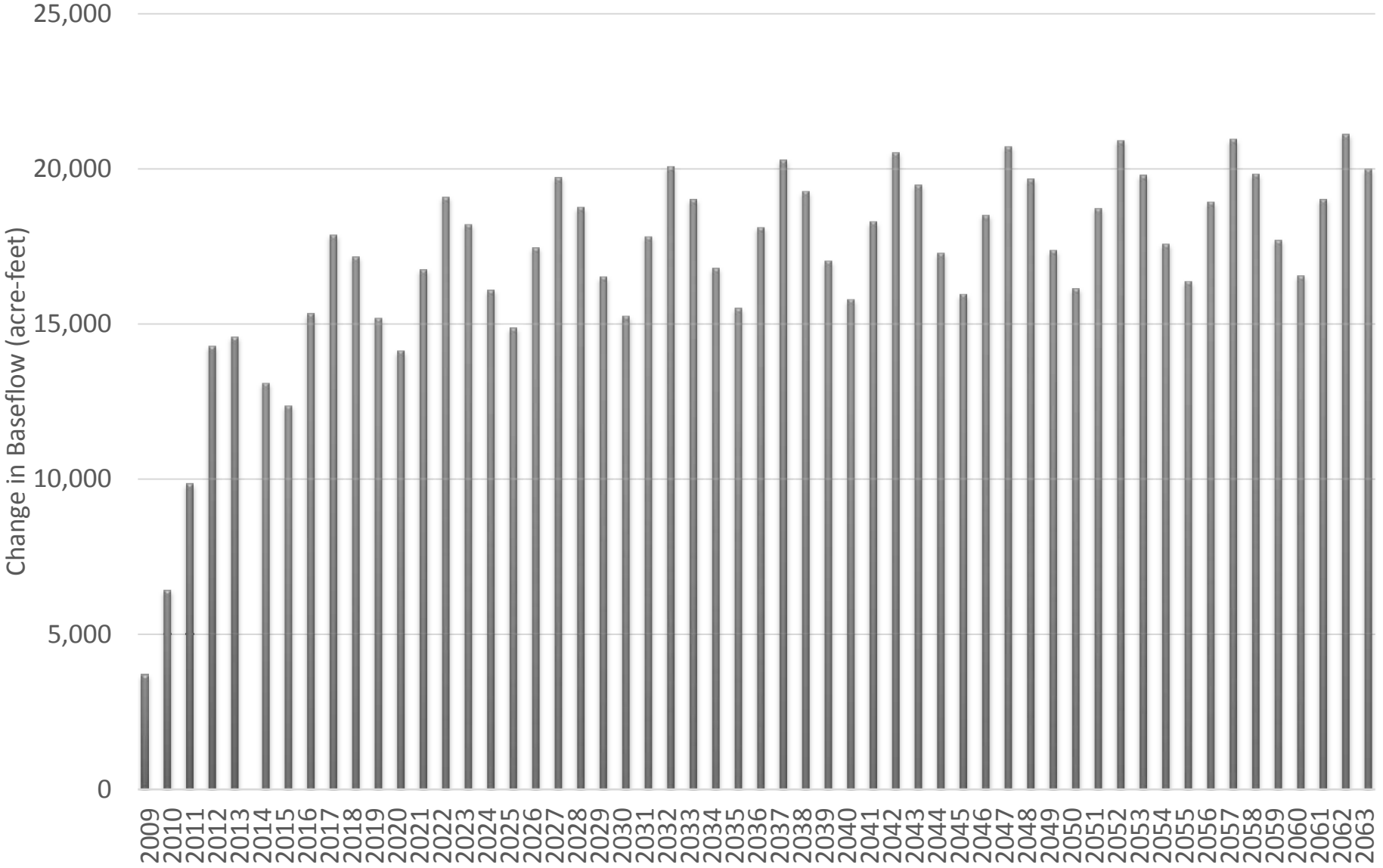
# NPNRD Alfalfa Only Lands
# Metered CU vs. Modeled CU



# NPNRD Small Grains Only Lands
# Metered CU vs. Modeled CU



# NPNRD Allocation Analysis: North Platte River and All Tributaries
## Annual Change in Baseflow (acre-feet)

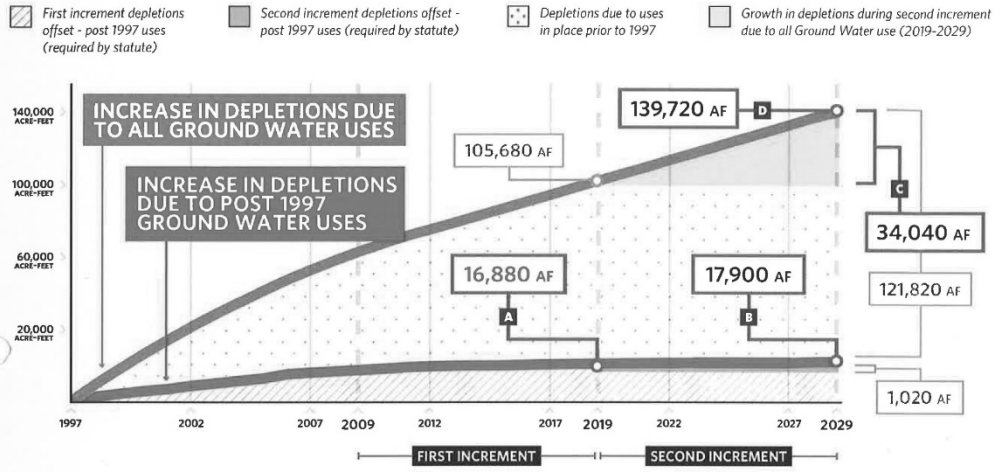


# Platte Basin Depletions

UPPER PLATTE BASIN

# Growth In Depletions

**BACKGROUND:** The First Increment of the Upper Platte basin-wide plan was adopted in 2009. It is a requirement that a technical analysis of the first basin-wide plan must occur in the ten years following its adoption. This technical analysis is needed to determine the path forward in order to achieve the goals and objectives set for the plan. First Increment efforts also worked to establish the overall difference between current and fully appropriated levels of development.




*Total depletions from all Ground Water uses in 1997 estimated 391,470AF. Data used to estimate increases in depletions due to all Ground Water uses is from the results of the most recent COHYST and WWUM models (2015). Data used to estimate increases in depletions due to post-1997 Ground Water uses is from previous analysis conducted by R. R. Luckey (2008). The robust review currently underway will provide updated data for both of these depletions estimates.*

## SECOND INCREMENT

The Single Planning Group will help define the progress towards fully appropriated conditions to be made during the second increment.

**A 16,880 AF**
**Starting point for Second Increment**
(mitigation of 16,880AF of depletions from post 1997 uses required in first increment)

***Range of estimated depletions offset benefits of first increment actions (43,600AF to 126,170AF)***

25,000 | 50,000 | 75,000 | 100,000 | 125,000 | 150,000

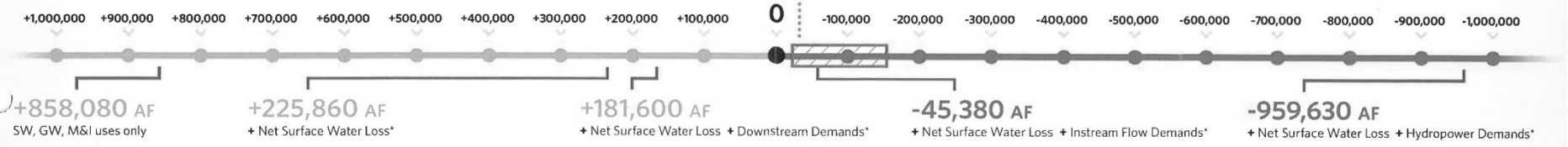
**B 17,900 AF**
Inciudes **1,020AF** growth in post 1997 use depletions *(2019-2029)*

**A + C 50,920 AF**
**16,880AF** of post 1997 use depletions *(1997-2019)*
**+34,040AF** growth in total depletions that includes **1,020AF** of post 1997 use depletions *(2019-2029)*

**D 139,720 AF**
Growth in total depletions *(1997-2019)*
Includes all post 1997 use depletions

## SUPPLY & DEMAND BALANCE

The Single Planning Group will help define the progress towards fully appropriated conditions to be made during the second increment. The scale below shows values taken from the Basin-Wide Supply and Demand Analysis.




**+858,080 AF**
SW, GW, M&I uses only

**+225,860 AF**
+ Net Surface Water Loss*

**+181,600 AF**
+ Net Surface Water Loss + Downstream Demands*

**-45,380 AF**
+ Net Surface Water Loss + Instream Flow Demands*

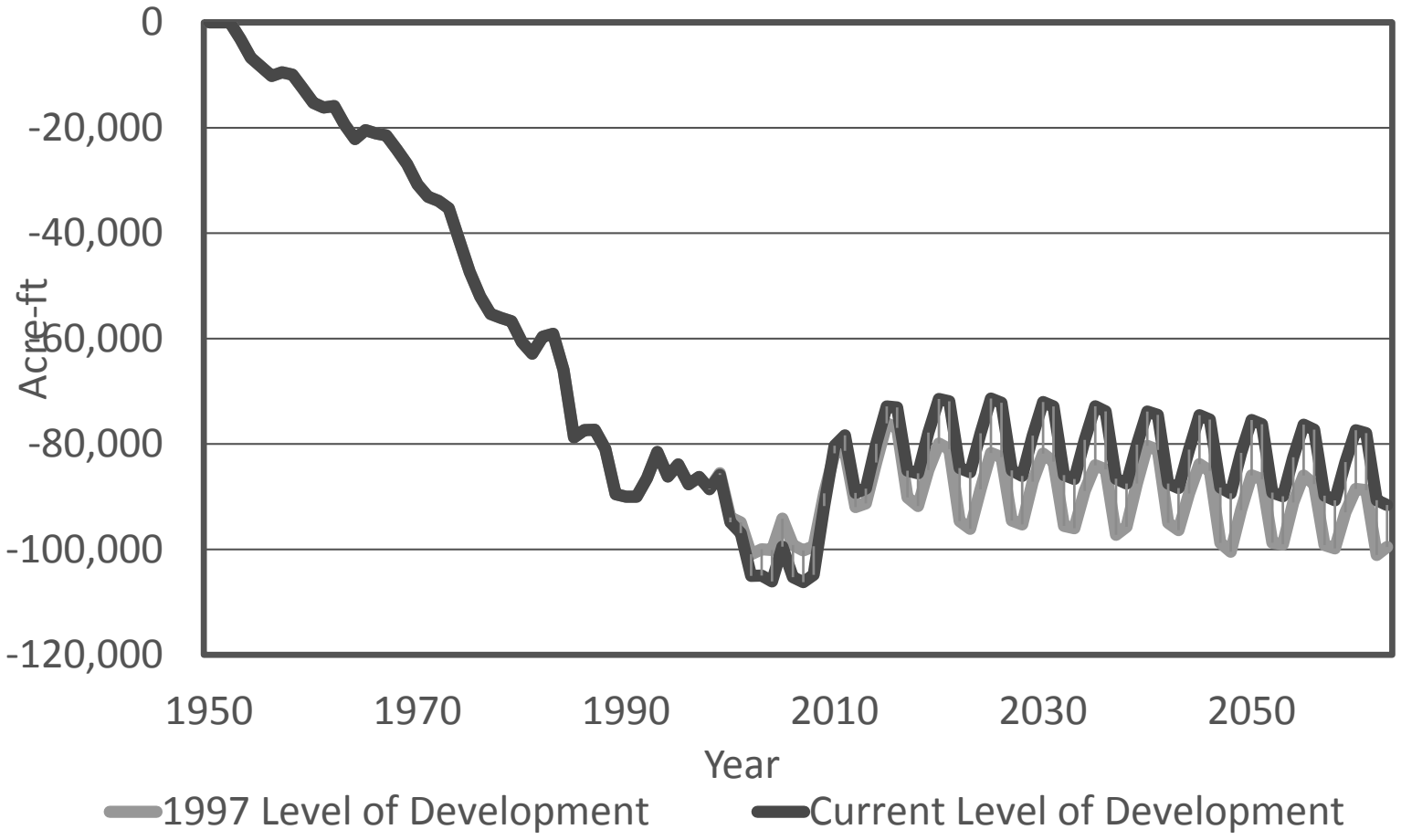
**-959,630 AF**
+ Net Surface Water Loss + Hydropower Demands*

** All figures reflect the average annual difference when comparing supplies with Surface Water (SW), Ground Water (GW), and Municipal and Industrial (M&I) consumptive uses.*

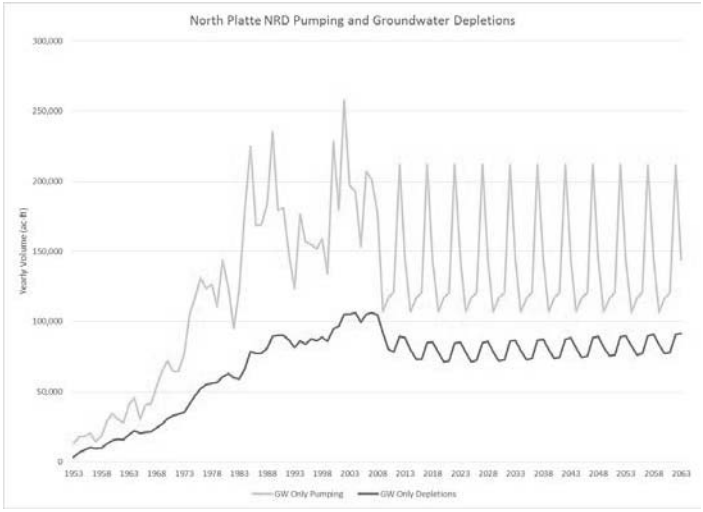
# North Platte NRD Potential Depletions Moving Forward

# NPNRD Total Depletions

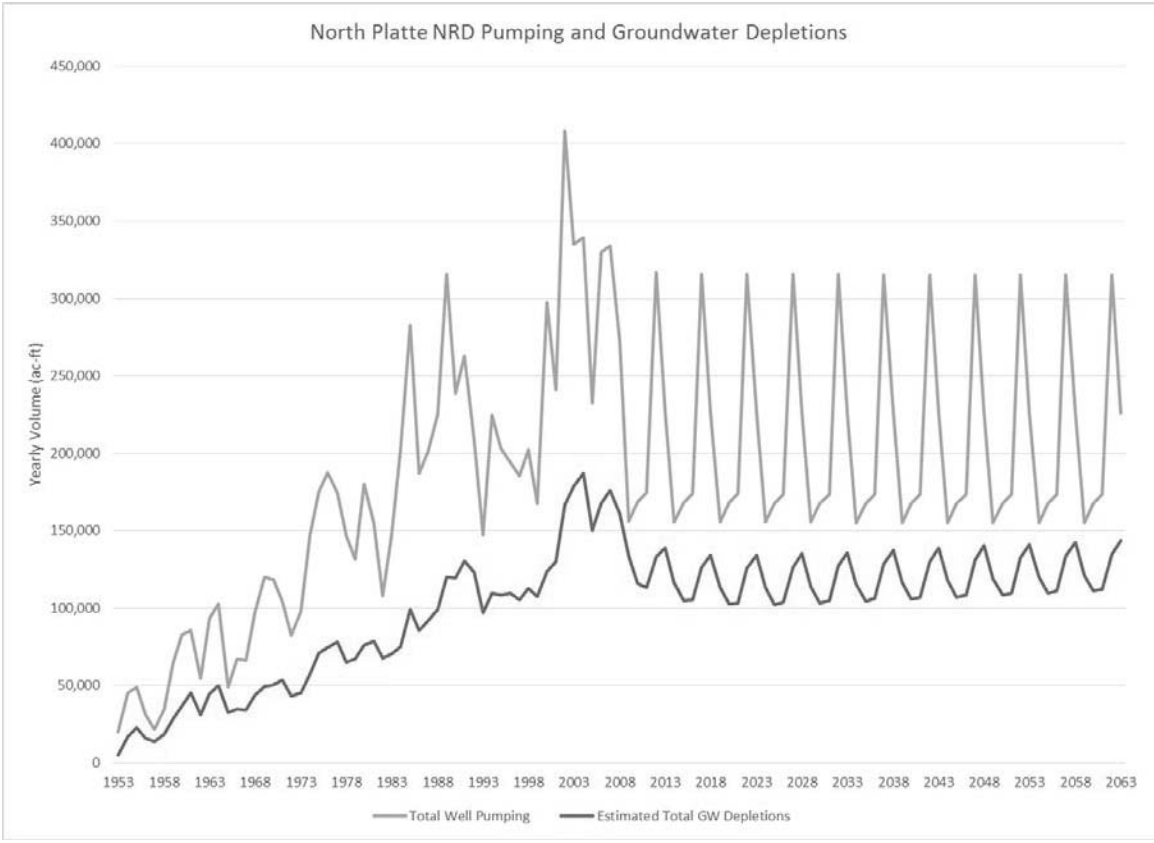
Groundwater Depletions Resulting from GW Only Wells



# Total Depletions




**GW Only**




**Total Pumping and Depletions with Commingled Wells**

# Thanks!

- Questions
- Comments