Conjunctive Water Management

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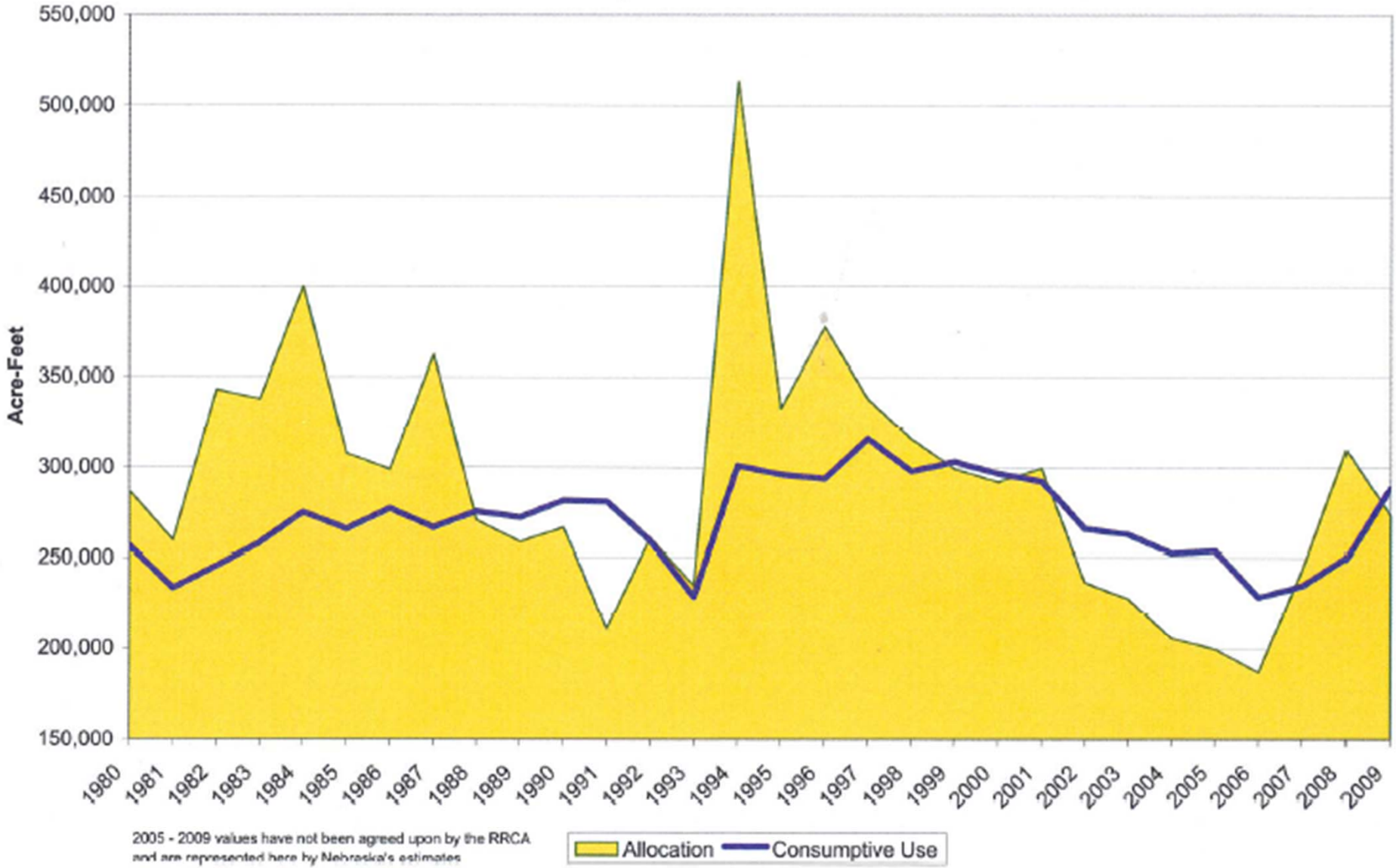
Outline

- Overview of What Conjunctive Water Management (CWM) Is and What the Benefits Are
- What Makes the Basins in Nebraska Good Candidates for CWM
- What Potential Benefits and Challenges Exist in the Republican Basin for CWM?

What is Conjunctive Management?

Nebraska Historical Allocation versus Nebraska Historical Consumptive Use



What is CWM?

- CWM is an adaptive process that utilizes the connection between surface and groundwater to maximize water use, while minimizing impacts to streamflow and groundwater levels in an effort to increase the overall water supply of a region and improve the reliability of that supply.

What is CWM? (cont.)

- Conjunctive management may be implemented to meet other objectives as well, including reducing groundwater overdraft, land subsidence, protecting water quality, and improving environmental conditions.

What is CWM? (cont.)

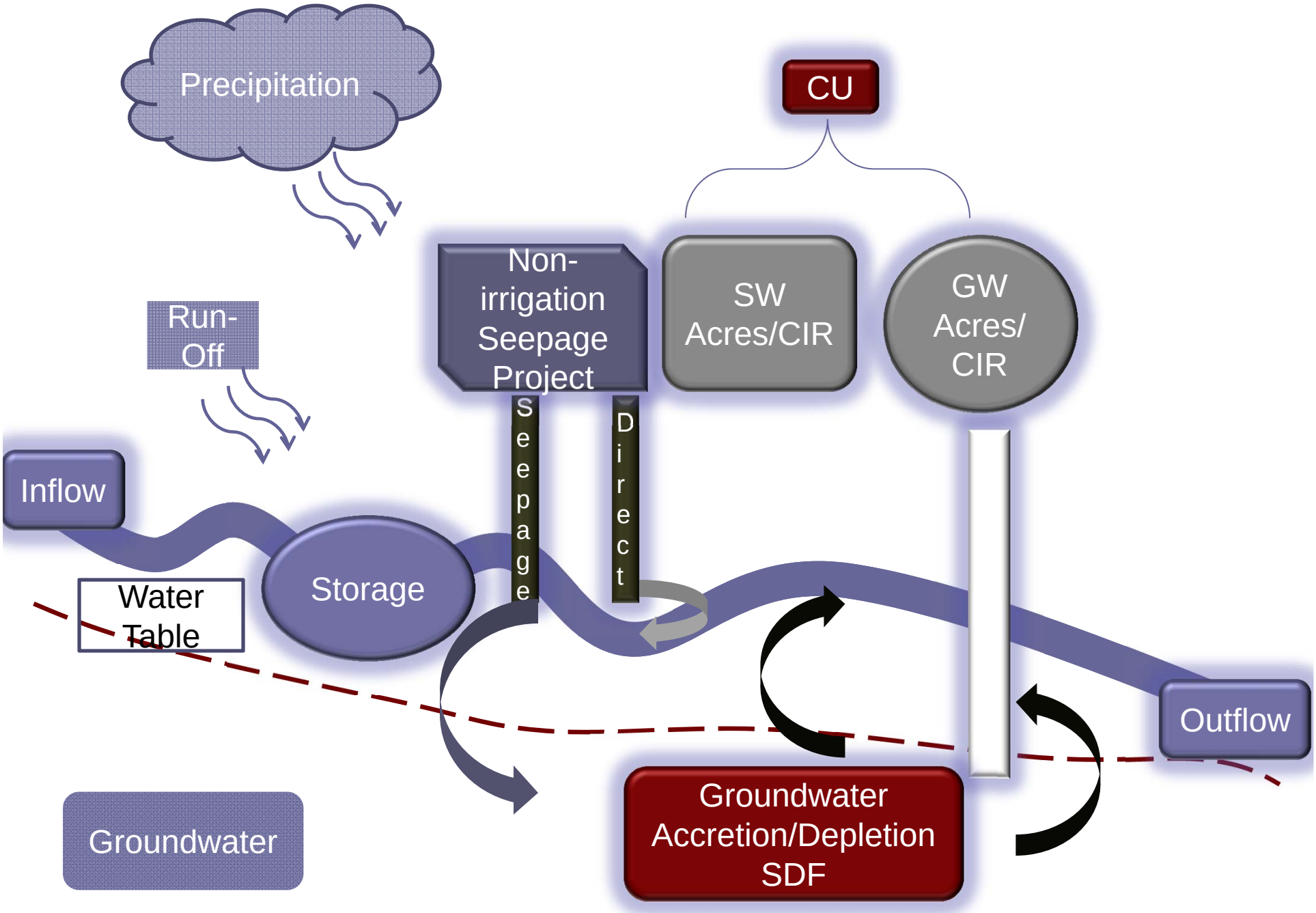
- The concept of conjunctive management is that surface and groundwater resources are hydrologically interconnected, and decisions to improve the management of one cannot be made properly without considering the other.

What is CWM? (cont.)

- Conjunctive management is typically accomplished by using or storing additional surface water when it is plentiful, and relying more heavily on groundwater during dry periods
- Conjunctive management can change the timing and location of water so it can be utilized more efficiently.

Components of CWM

- Although a specific project or program may be extremely complex, there are several components common to all conjunctive management projects.
  - Diverting SW and Pumping GW
  - Aquifer Recharge
  - Management of Return Flows (Timing)
  - Monitoring and Evaluation Program


Precipitation
CU
Non-irrigation Seepage Project
SW Acres/CIR
GW Acres/ CIR
Run-Off
Seepage
Direct
Inflow
Storage
Water Table
Outflow
Groundwater
Groundwater Accretion/Depletion SDF

What are the benefits of CWM?

- Maximize the available water supplies
- Leverage existing infrastructure
- Utilize existing planning framework
- Minimize the need for regulatory actions

What are the benefits of CWM? (cont.)

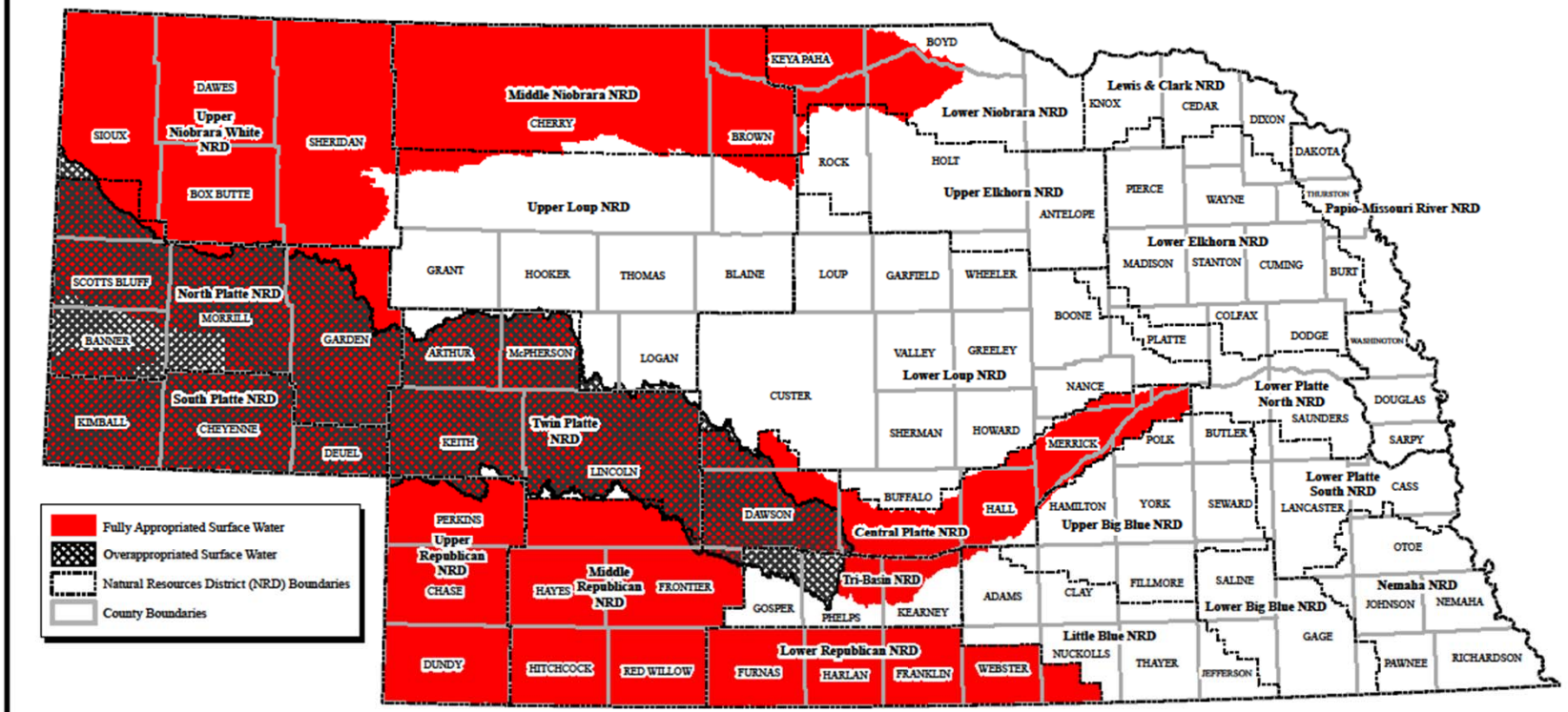
- Customized to local opportunities or needs
- Input from stakeholders and public for potential objectives
- Maintain viability of existing uses

What Makes Nebraska a Good Candidate for CWM?

Fully Appropriated and Overappropriated Surface Water in Nebraska

Determinations made by the Department of Natural Resources as of April 08, 2009

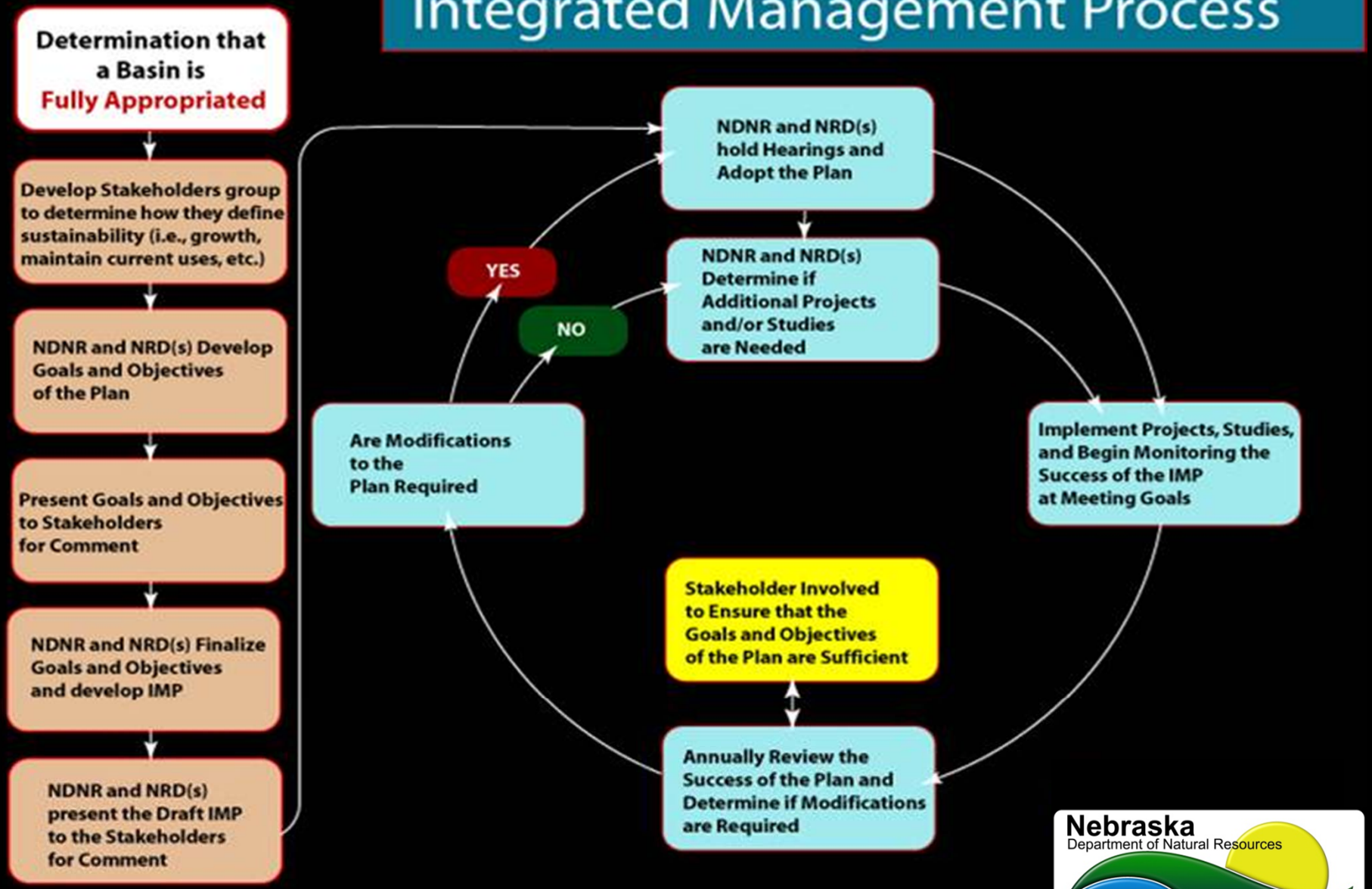
Mapping Section



This map represents all areas in Nebraska where the surface water resources have been determined to be fully appropriated or overappropriated by The Department of Natural Resources (DNR) as of April 08, 2009. Detailed information regarding these determinations can be found in the individual Notices and Orders issued by DNR.

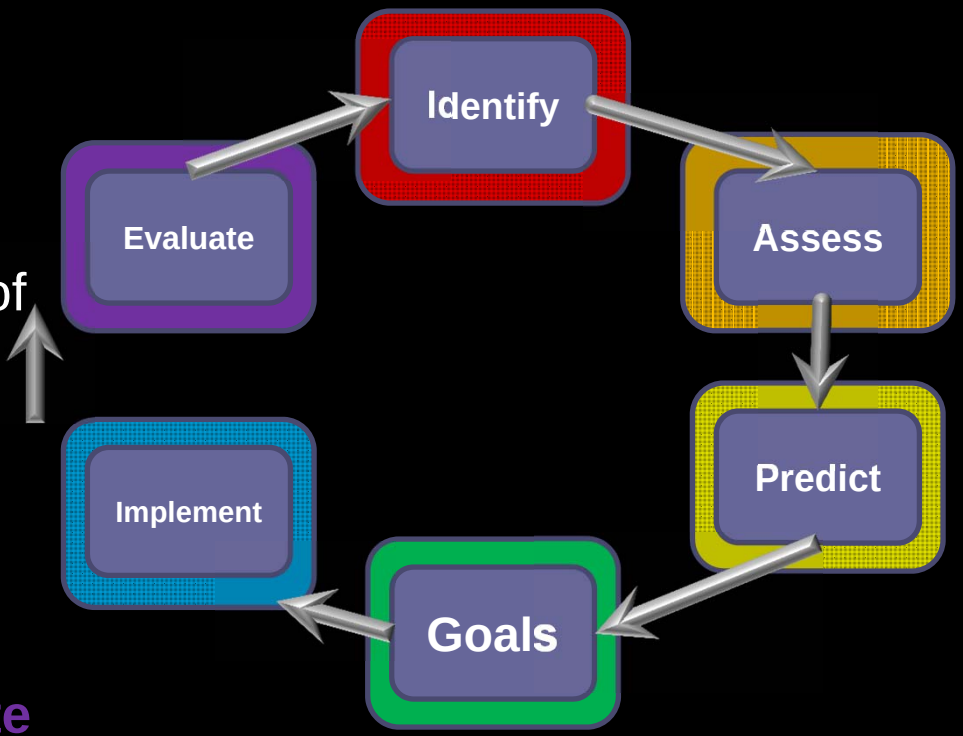
Map produced by Daniel Kloch - April 2009

Integrated Management Process



Steps to Successfully Implement CWM

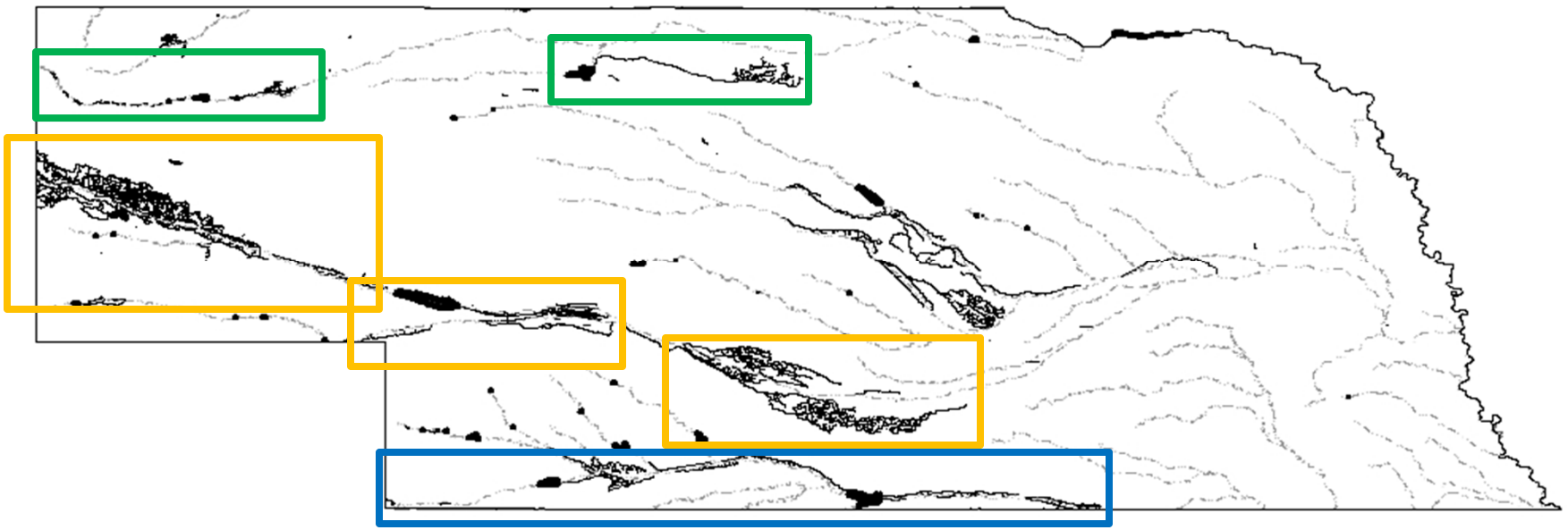
- **Identify** the basin goals and concerns
- **Assess** the water supply and water demands
- Develop an **Understanding** of the basin to **Predict** system response to perturbations
- Set management **Goals**
- **Implement** management strategy
- **Monitoring Plans** to **Evaluate** project ability to meet goals



CWM in Nebraska

- Republican River – current average 40,000+ acre-feet (over 5 years)
- Platte River – historical analysis suggests several hundred thousand acre-feet per year above Overton
- Niobrara River – Estimated excess to Spencer hydro of around 100,000 acre-feet per year

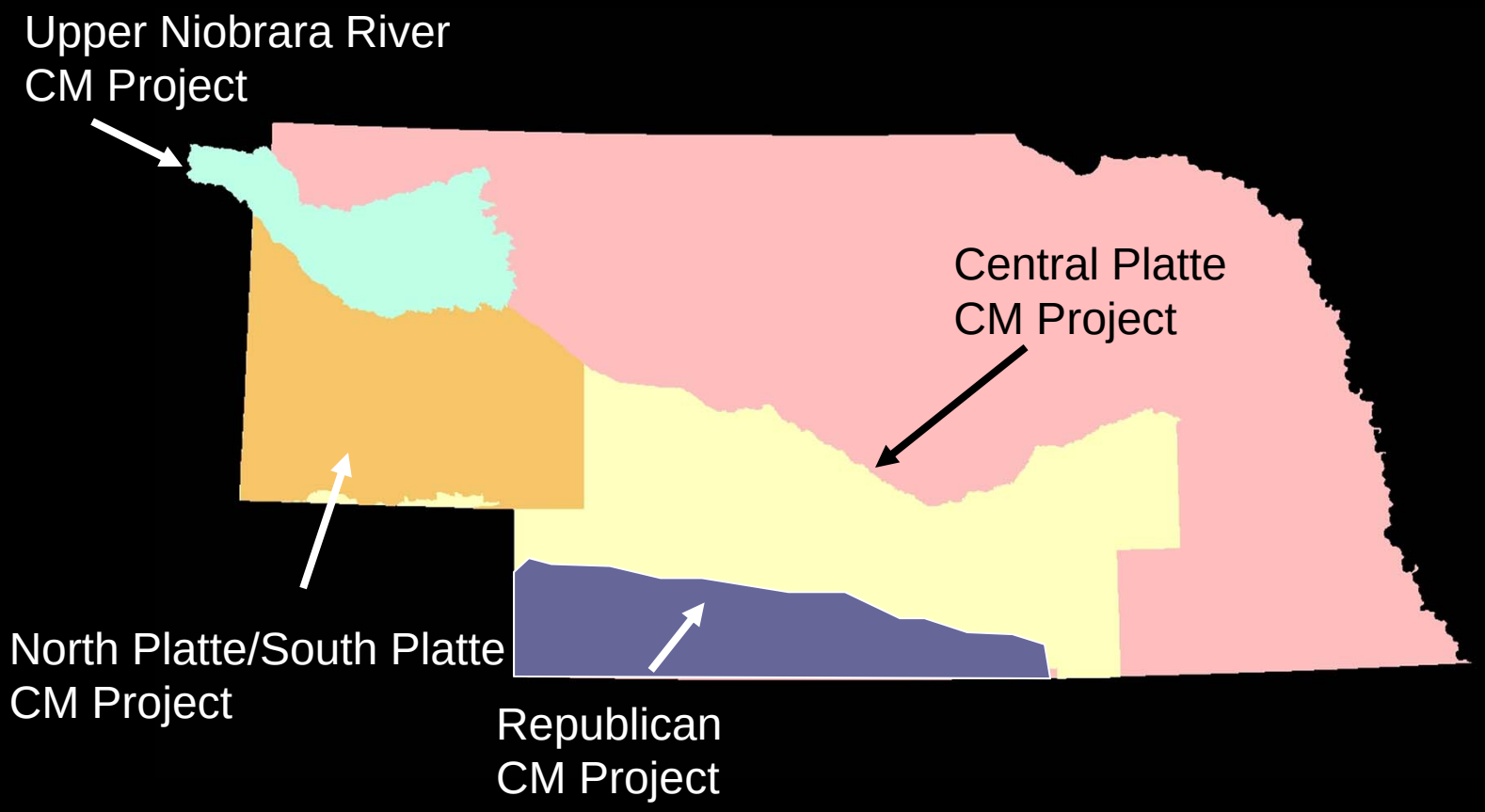
NEBRASKA IRRIGATION INFRASTRUCURE



0 30 60 120 180 240
Miles

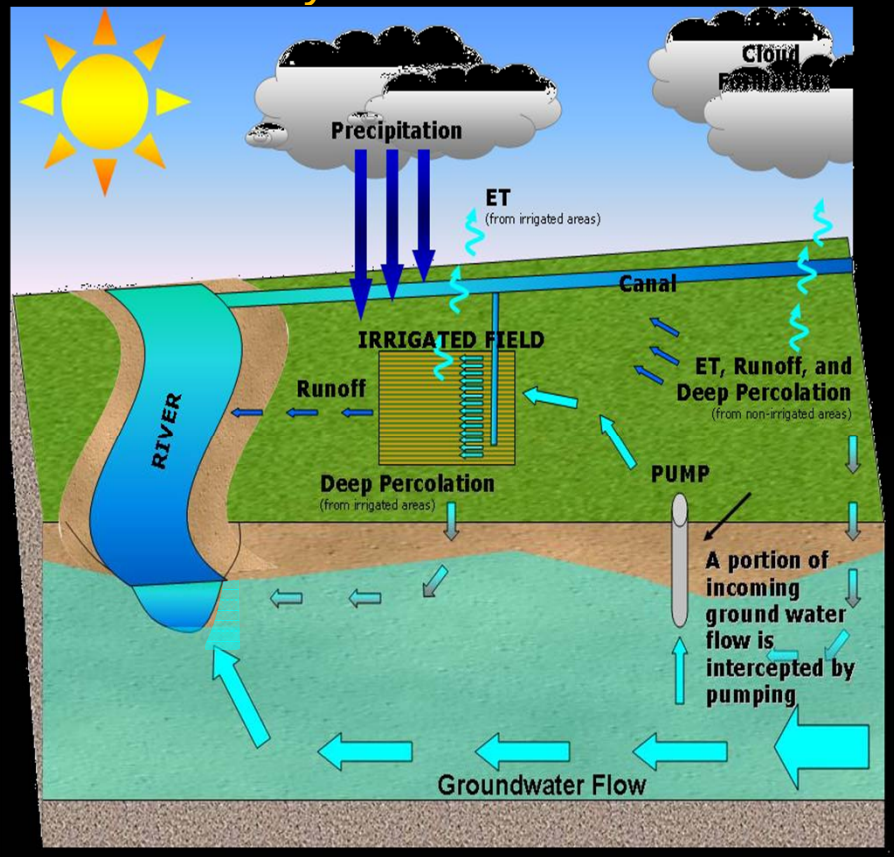
Hydrography from the National Hydrography Dataset (NHD)

Where is CWM Currently Being Planned for Implementation?

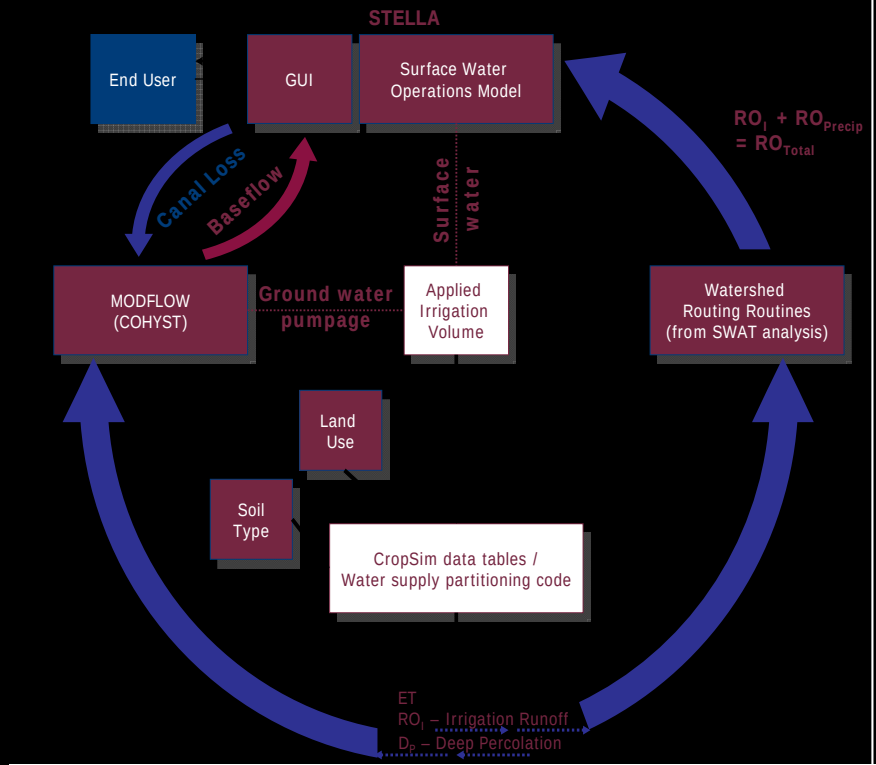


Modeling Tools Support Informed Decision Making

Physical Basis

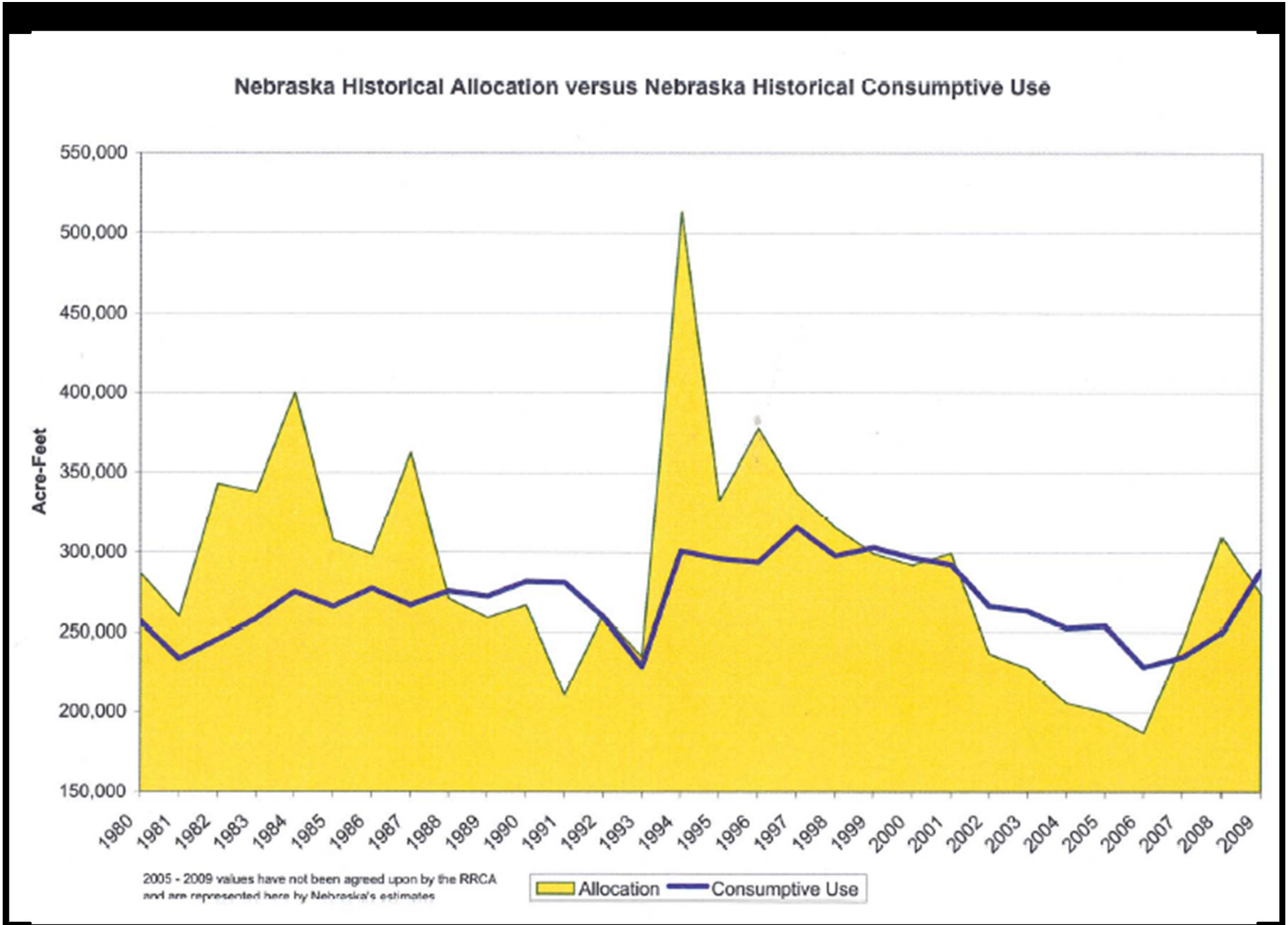


Models



$ET = CIR\ (1 - (1 - I/GI)^{1/B})$ $Dp \sim f(ET, SL)$ $RO_I \sim f(Dp, TL, SL)$

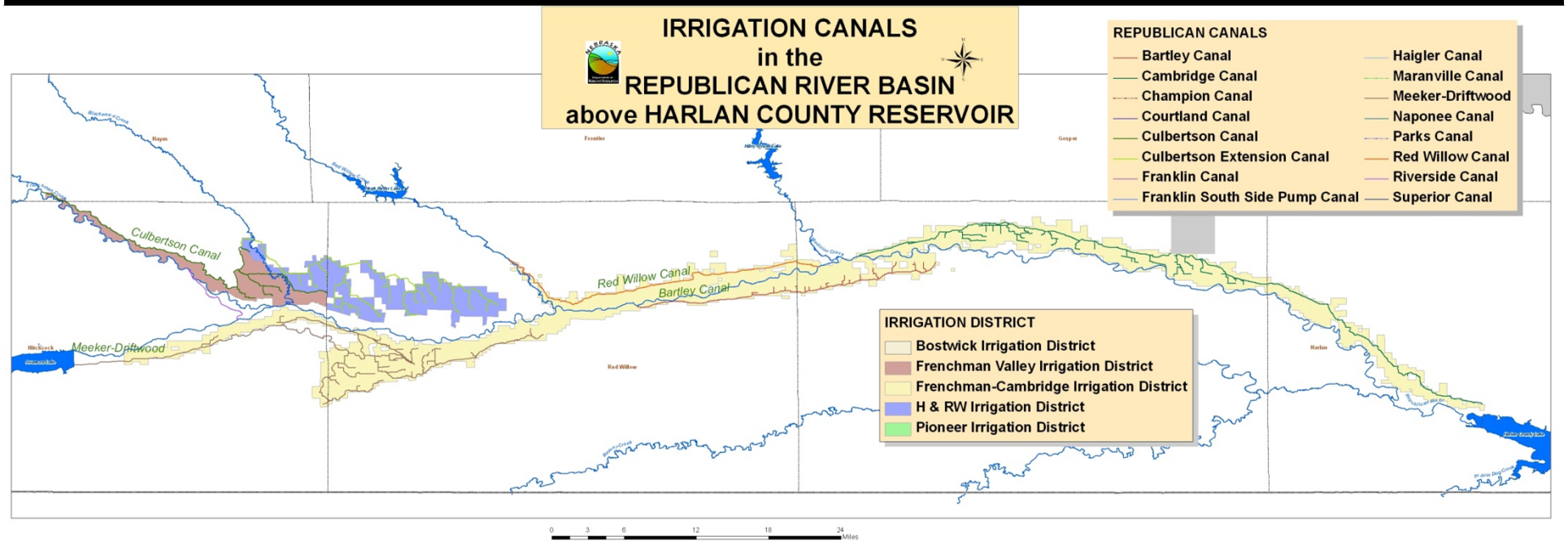
What Potential Benefits and Challenges Exist in the Republican Basin for CWM?


Nebraska Historical Allocation versus Nebraska Historical Consumptive Use
Acre-Feet
550,000
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2005 - 2009 values have not been agreed upon by the RRCA
and are represented here by Nebraska's estimates
Allocation
Consumptive Use

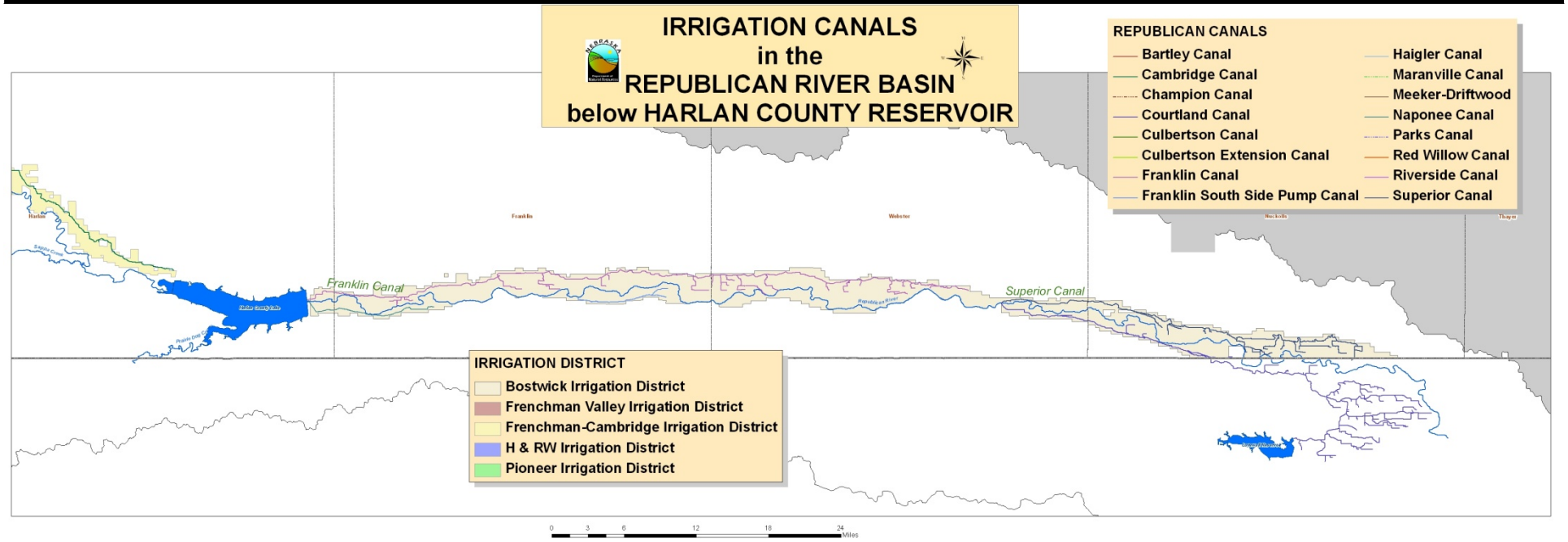
Annual Compact Balances for Current Five-Year Average

Year	Hardy Accounting Point
2006	-29,116
2007	30,843
2008	84,998
2009	10,266
2010	116,143
Average	42,630

Upper Republican River Basin Existing Infrastructure



Lower Republican River Basin Existing Infrastructure

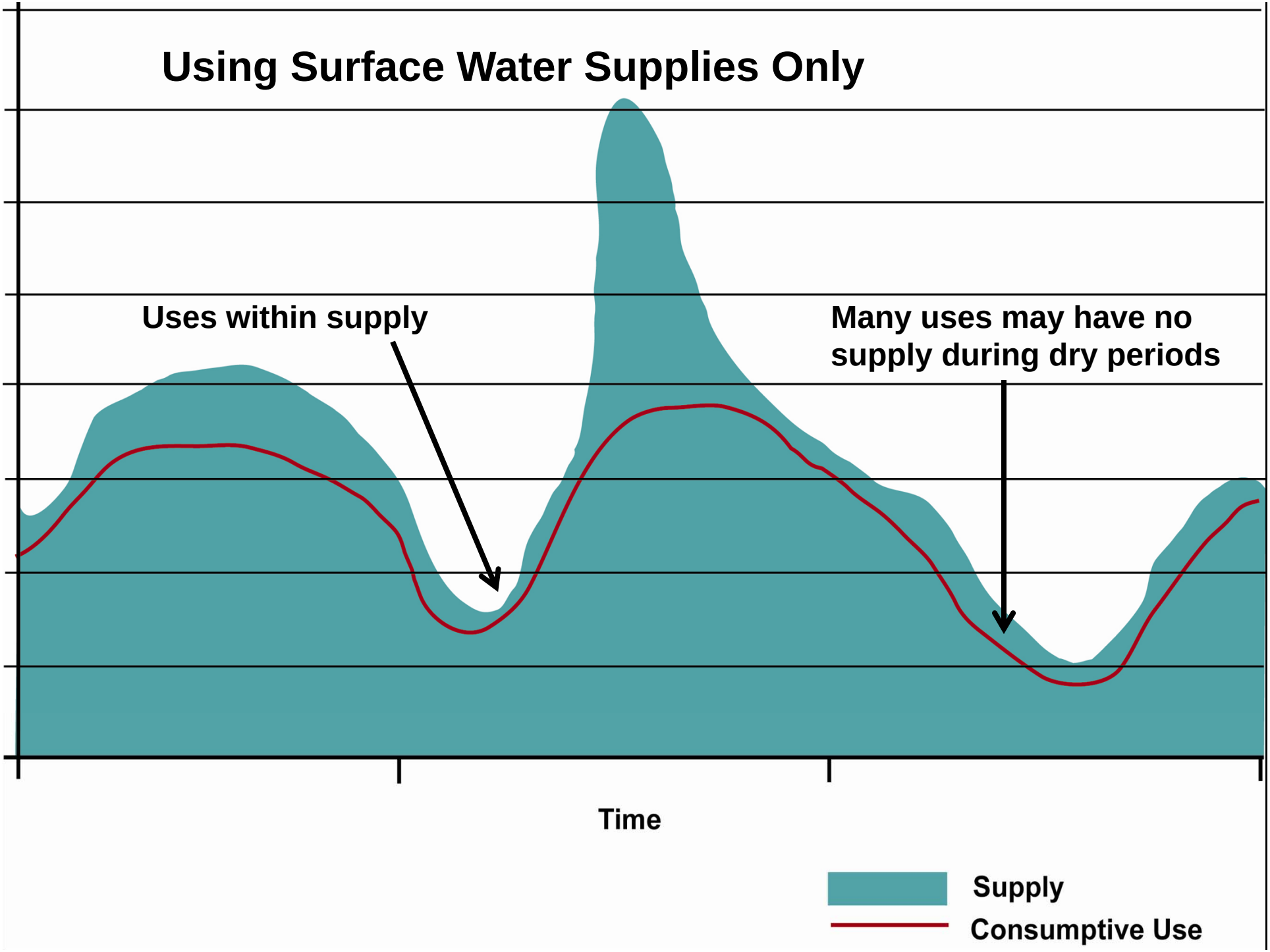


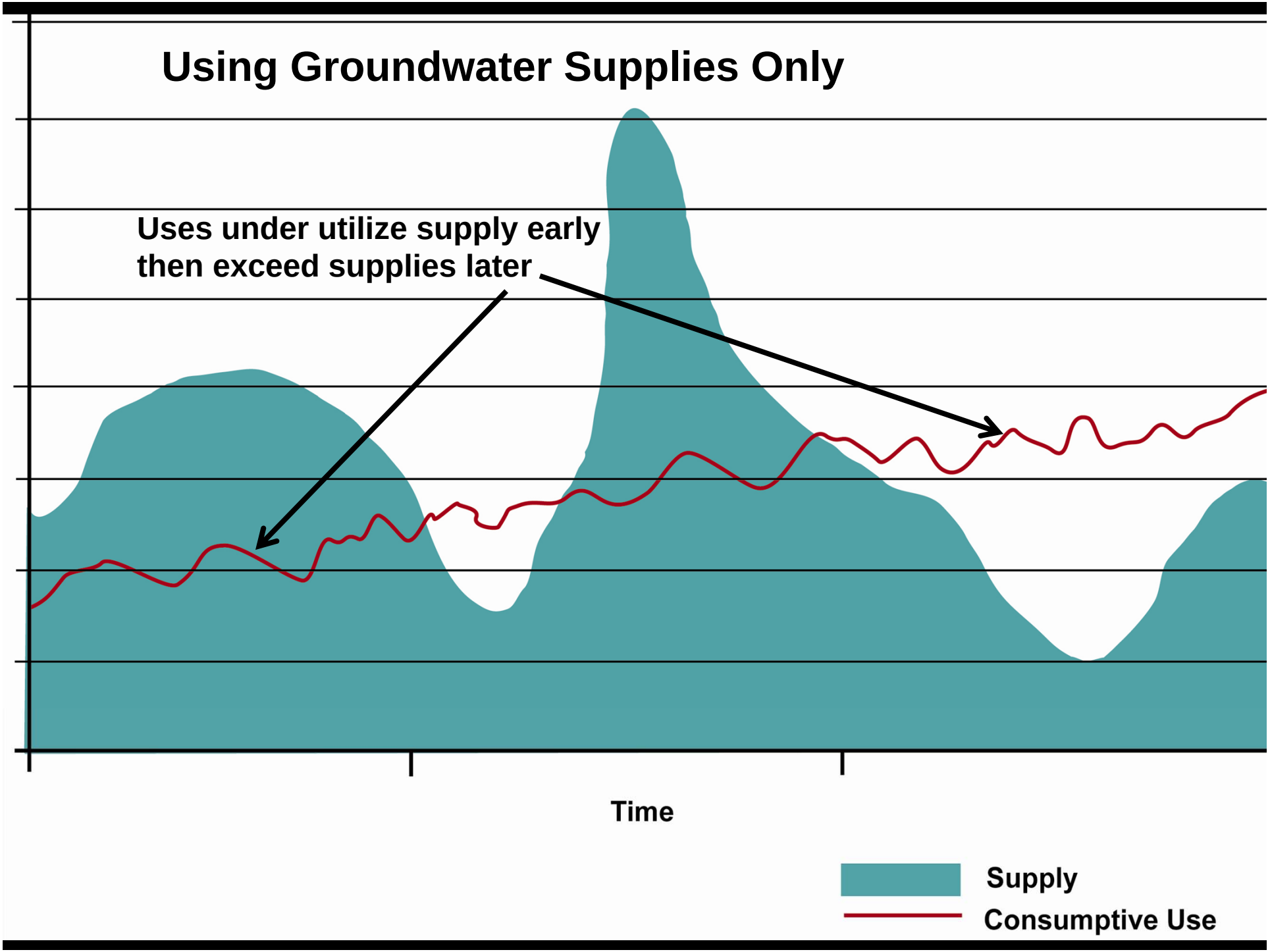
Integrated Management Plans

Year	Item	Information Source
T – 3		Draft; current Accounting Procedures (v. 2005)
T – 2		Draft; current Accounting Procedures (v. 2005)
T – 1		Draft; current Accounting Procedures (v. 2005)
Provisional Data for T = 0 (Current Year or Immediate Past Irrigation Season)	Pumping	Power records estimate
	Surface Water Use	Estimated from preliminary data and previous years values
	Stream Flow	Available provisional records end of year estimated
	Evaporation	T – 1 records
Forecast Year T + 1 (Coming Irrigation Season)	Ground water Consumptive Use and Imported Water Supply Credit	Average values for T = 0 and T - 1
	Surface Water Consumptive Use	Colorado: Average of T – 1 and T – 2 use Kansas: + (.1858 x HCL content) + 9,575 Nebraska: - $(4x10^{-7})$ x (NE lake volume)^2 + (0.52) x (NE lake volume) - 42,000
	Stream Flow	+ (5-year average of state line flows) x 0.41 + 0.23 x HCL content - 27,450

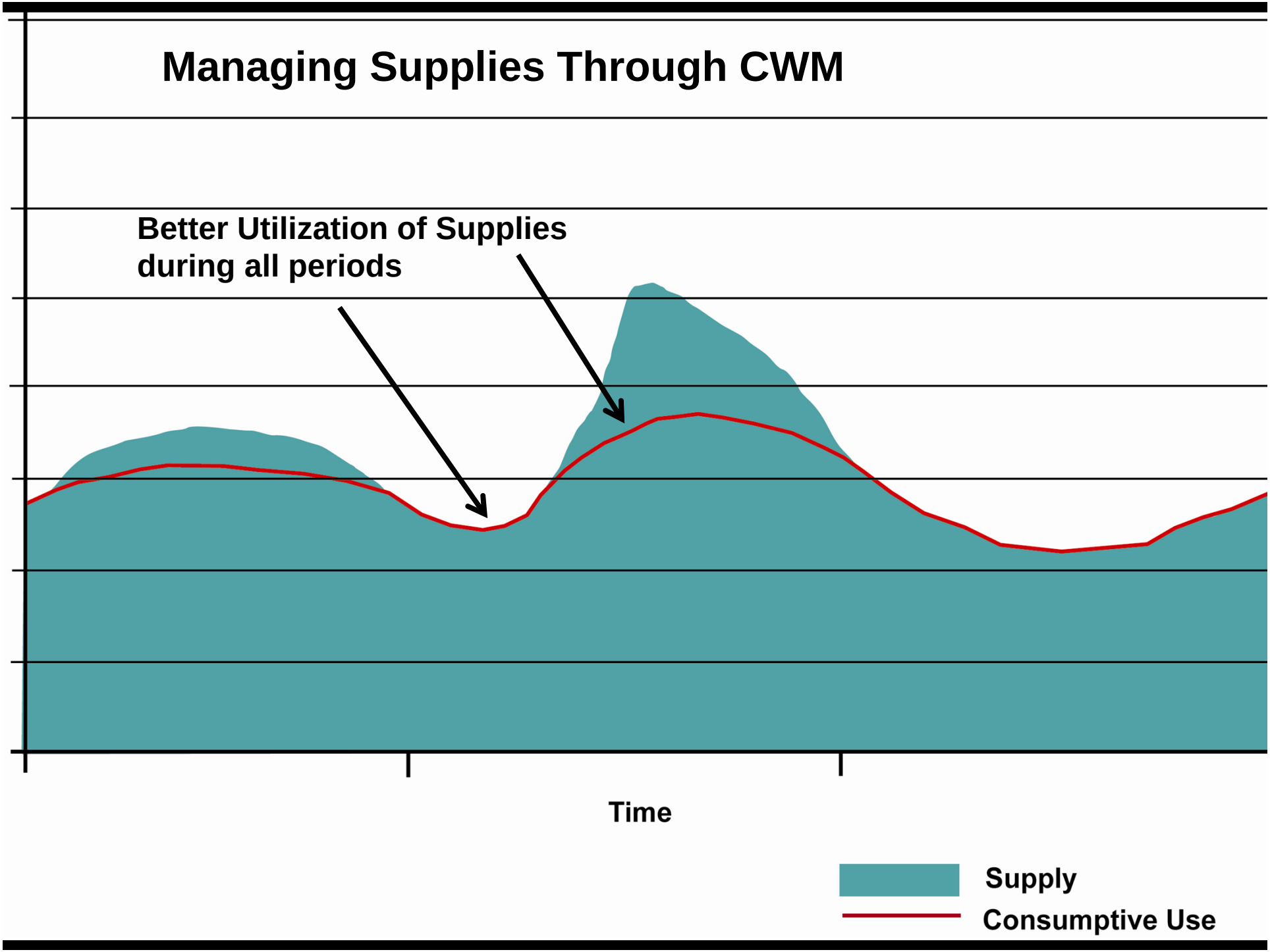
Example(s) of Benefits

- The following examples illustrate the non-utilized water under 3 different management scenarios
  - Surface water only
  - Groundwater only
  - CWM strategy through integrated management


Using Surface Water Supplies Only
Uses within supply
Many uses may have no supply during dry periods
Time
Supply
Consumptive Use


Using Groundwater Supplies Only
Uses under utilize supply early
then exceed supplies later
Time
Supply
Consumptive Use

Managing Supplies Through CWM



Challenges of CWM in the Republican River Basin

- The temporal and spatial aspects of the water supply need further study
- Administrative aspects (complex transfers, existing authorizations, etc.)
- Need for close collaboration and cooperation to find equitable solutions

Benefits of CWM in the Republican River Basin

- There is a water supply
- There is infrastructure
- There is a solid planning process and monitoring procedures
- There is a forecasting mechanism
- There are hydrologic tools developed
- There are benefits to all water users

Summary

- CWM is the coordinated and combined use of surface water and groundwater to increase the overall water supply of a region and improve the reliability of that supply.
- CWM can play a key role in meeting goals and objectives of integrated management.

Summary (cont.)

- CWM requires ongoing monitoring to evaluate operations and allow water managers to respond to changes in groundwater, surface water, or environmental conditions that could violate management objectives or impact other water users.
- With close collaboration between all water users in the basin, CWM can provide basin-wide benefits to all water users.

Questions?

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http://dnr.ne.gov/IWM/Reports/ConceptualDesignConjunctiveMgmt_032811.pdf