

Integrated Water Management Modeling in Nebraska

American Water Resources Association Conference

Reno, Nevada

July 2, 2014

Mahesh Pun, EIT

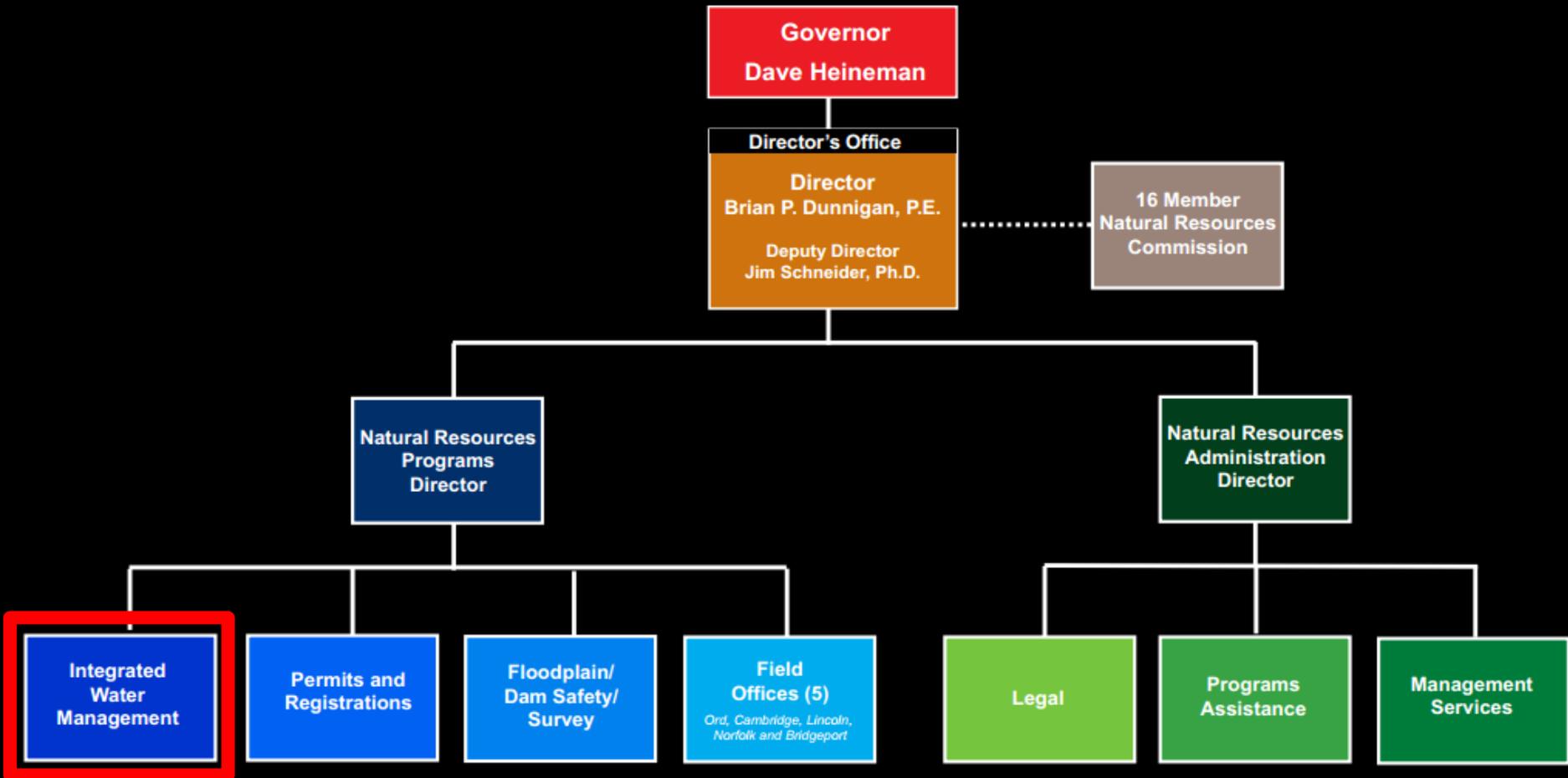
Integrated Water Management Analyst

Nebraska Department of Natural Resources





Nebraska Department of Natural Resources



What we do:

Provide
technical expertise,
planning, and
coordination

Develop
models

Conduct
studies

Help water
managers

Collaborate
with NRDs
and other
stakeholders

To help better understand:

- Nebraska's water supplies and uses
- The effects of potential water management strategies

<http://dnr.ne.gov/insight/>

INSIGHT

An Integrated Network of Scientific Information & GeoHydrologic Tools

HOME

ABOUT

MODELING DATA



SELECT BASIN ▾

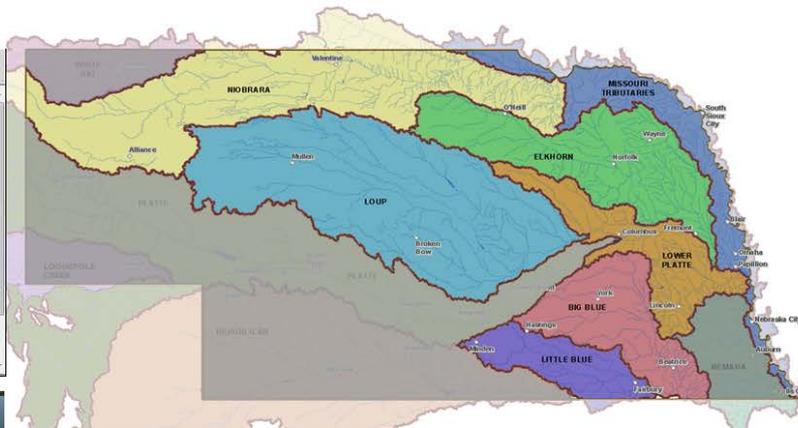
Welcome to INSIGHT. The data and charts represent our first release and we anticipate modifications and updates based on user feedback. Please [click this link](#) if you would like to provide a comment or suggestions.

Getting Started with INSIGHT

Use this page to get started using INSIGHT.

Begin by exploring hydrologic data for supplies, demands, and nature and extent of use for the state of Nebraska in the charts and graphs found in the tab area below. If you would rather learn more about hydrologic conditions for one of the state's basins and corresponding subbasins, use your mouse to hover over the map to the right and click on the basin you want to learn more about. Alternatively, you can select a basin from the drop-down menu just to the right of the map by clicking on the arrow ▾ next to **SELECT BASIN**. Clicking on one of these basin names has the same effect as clicking on the basin in the map.

Note that the map has some greyed-out areas. These areas, including the White-Hat, Platte, Lodgepole Creek, and Republican basins have limited data and/or are currently not available.

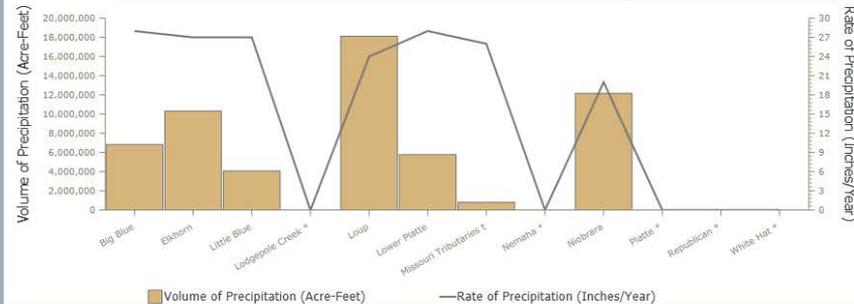


Supply Demand Nature & Extent of Use



Chart: Precipitation Rates and Volumes by Basin

Season: Annual



Supply

Basin water supplies represent the *streamflow* water supply that is available for total use within a river basin or subbasin. If no surface water or groundwater use was occurring by humans in a basin, the basin water supply would be represented by the streamflow data captured at a streamflow gaging station. However, streamflow is impacted by human activity; therefore, to calculate a total basin water supply, three water supply components are added together. These three water supply components include:

1. Streamflow
2. Surface water consumptive uses
3. Groundwater depletions

The charts found in this tab include:

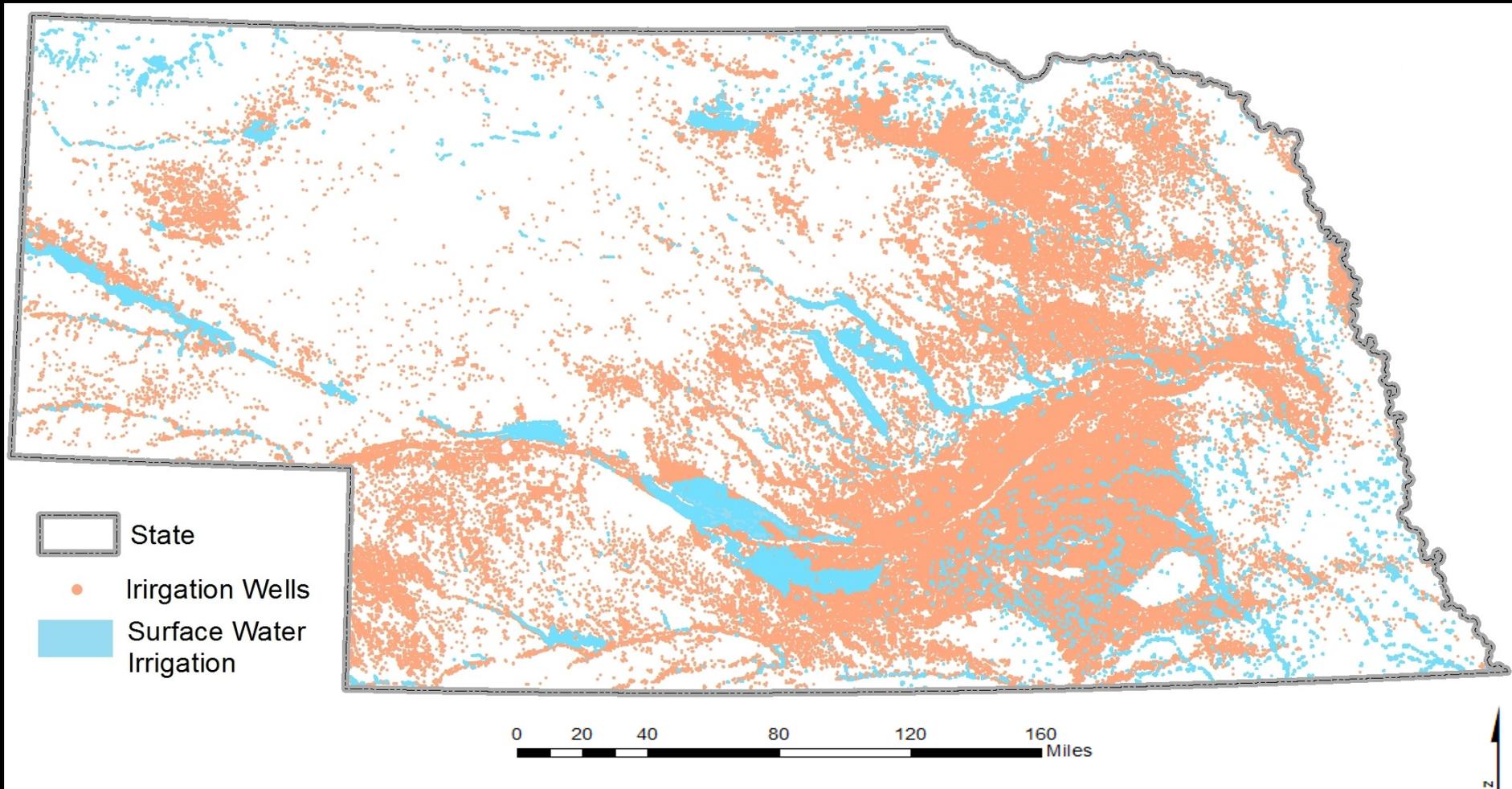
Introduction and Background

- Anthropogenic use of water resources has induced changes in both surface water and groundwater systems
- Change in one system may affect the other systems
- Need for effective management of water resources
- Need for a better understanding of
 - Interaction between surface water and groundwater systems
 - Land use and Climate system

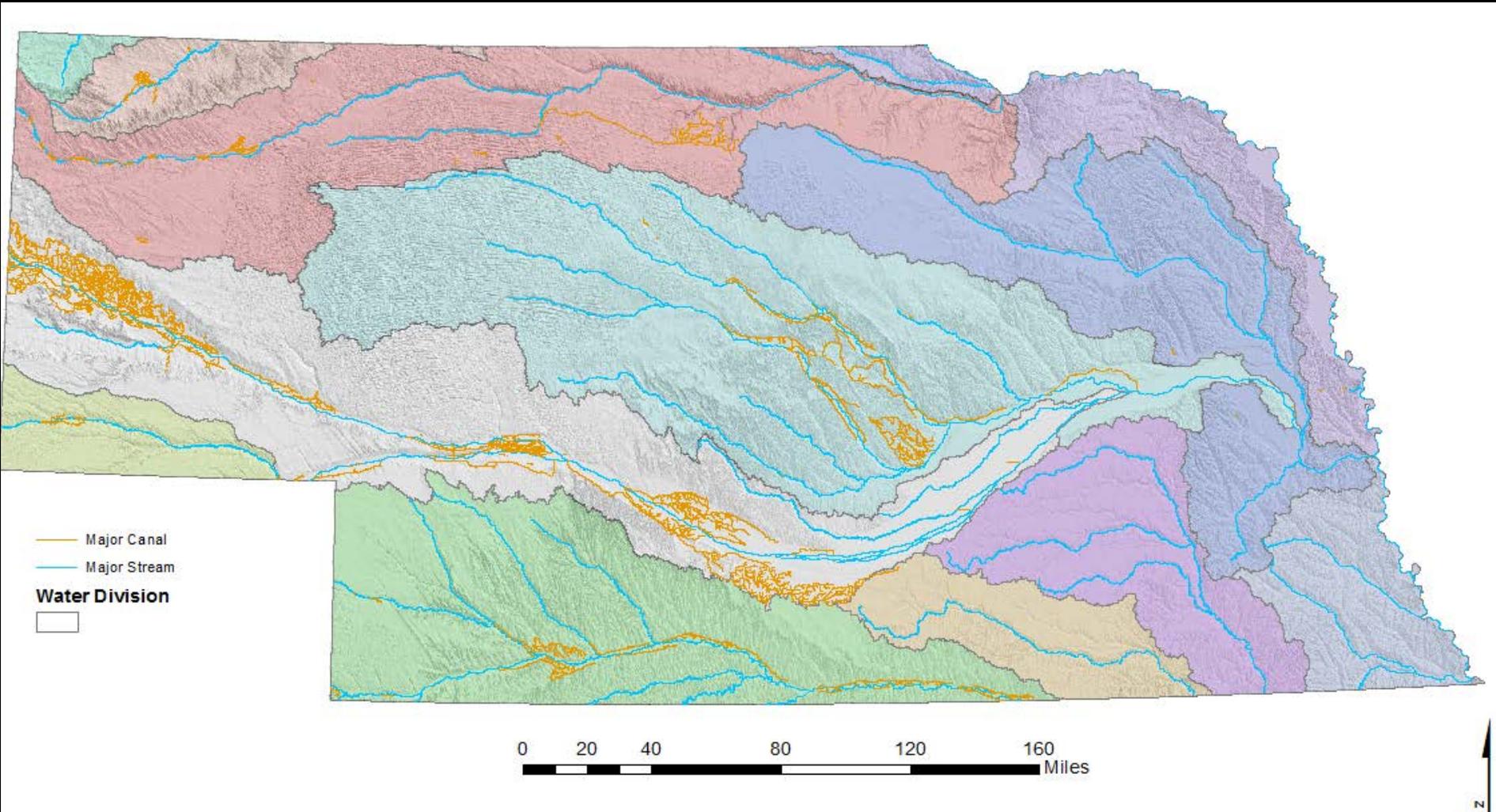
Introduction and Background

- Integrated Water Management (IWM) Model for understanding interactions between different systems
- Active interactions between hydrological components during water resources modeling, calibration, and analysis process
- Integrated Water Management (IWM) Model for
 - Evaluation of basin water supply and use
 - Effective management of water resources
- Identify the difference between levels of water resources development

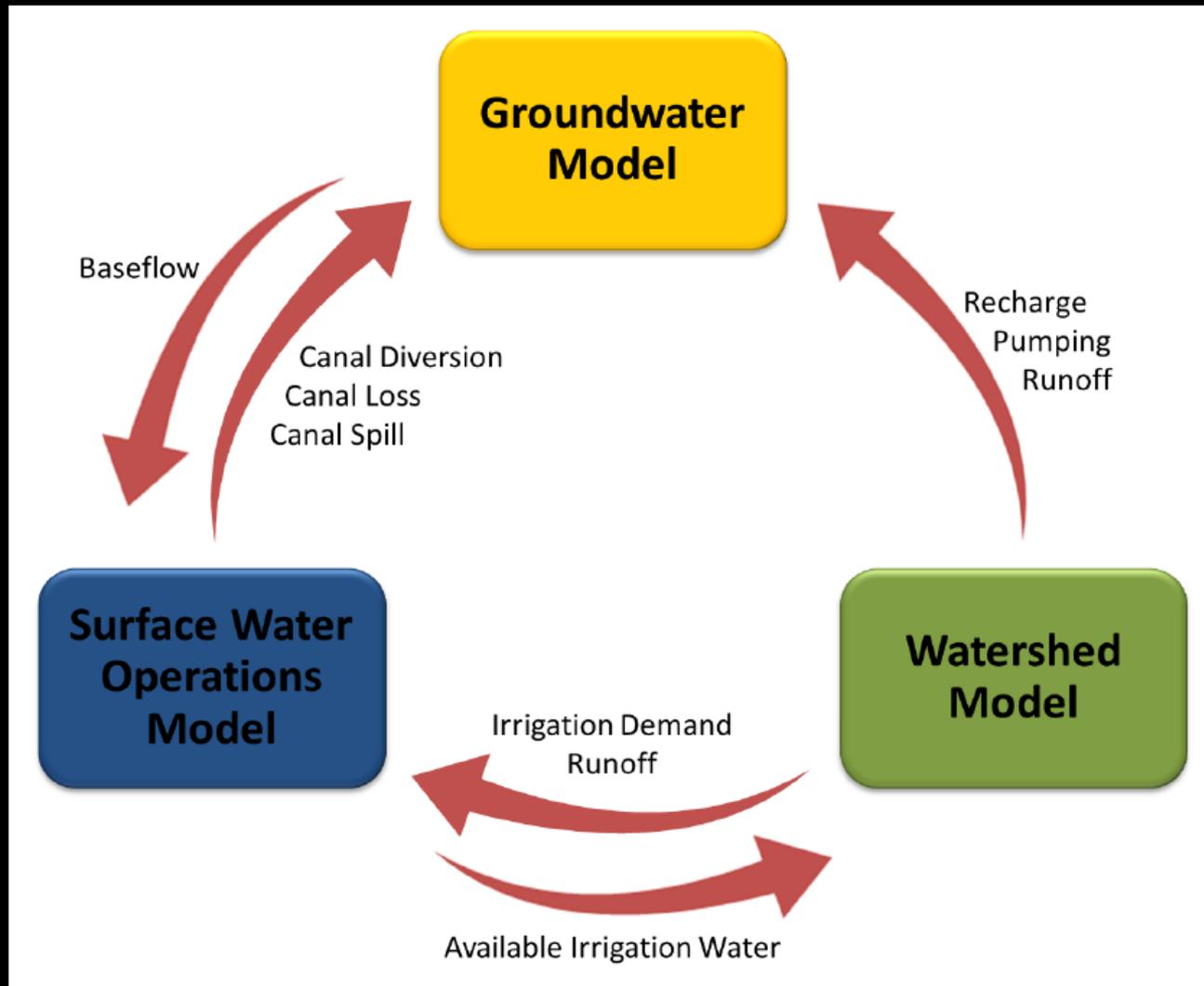
Introduction and Background



Introduction and Background



Framework for IWM Modeling



Framework for IWM Modeling

Surface Water Operations Model

- **Model Input Consideration:**
 - Reservoirs and canals
 - Water diversions and returns from streams
 - Water rights and priorities
 - Rules and operations of surface water
 - Natural flows and storage flows
- **Model Output Information:**
 - Available surface water to meet crop demands
 - Reservoirs and canals seepage
 - Spills and diversions into streams
 - Water budget of surface water operation system

Framework for IWM Modeling

Watershed Model

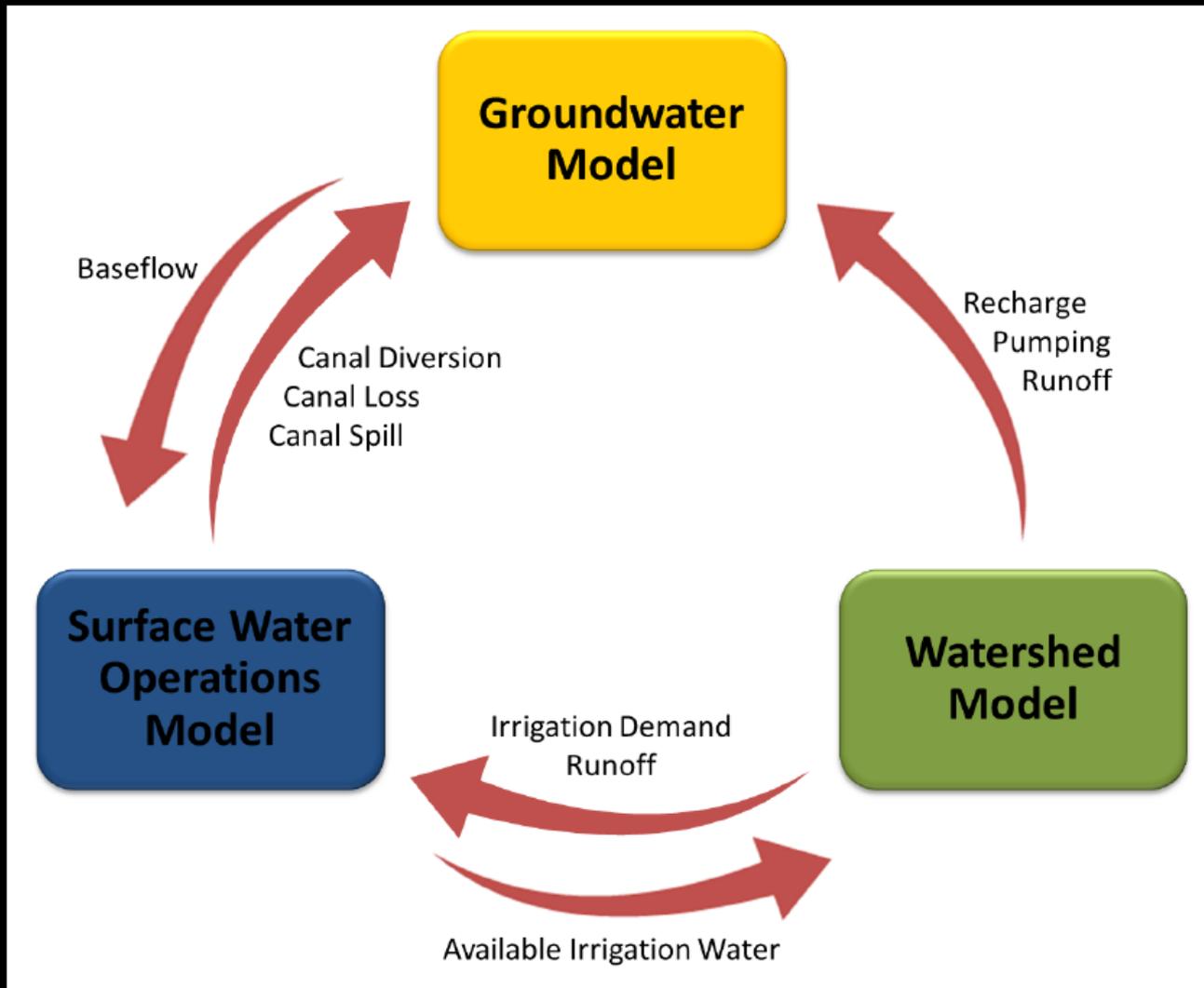
- **Model Input Consideration:**
 - Weather data from climate stations
 - Soil information
 - Crop characteristics
 - Agriculture management practices
- **Model Output Information:**
 - Aquifer recharge
 - Surface water irrigation
 - Groundwater pumping
 - Overland runoff

Framework for IWM Modeling

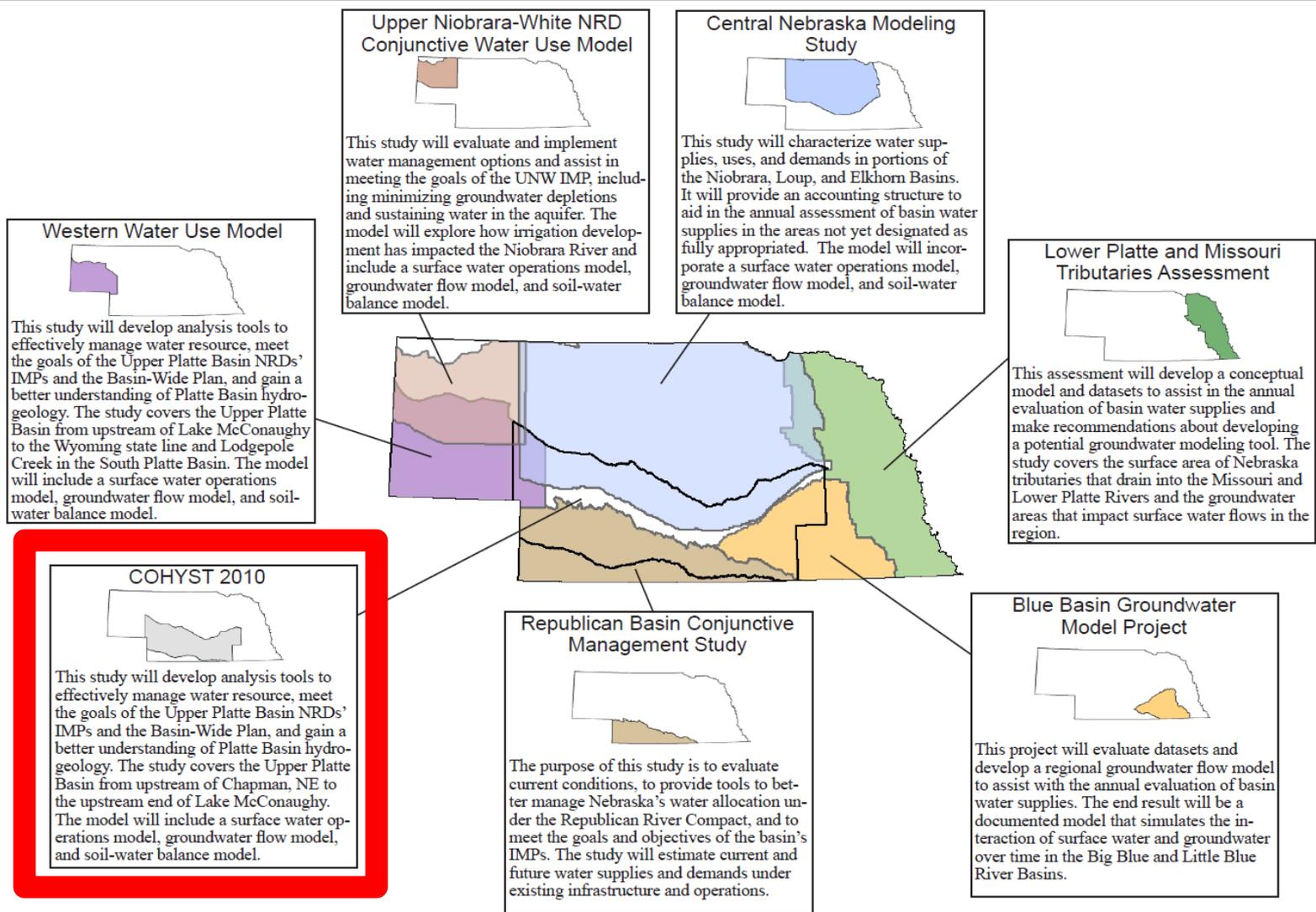
Groundwater Model

- **Model Input Consideration:**
 - Aquifer properties
 - Streams and reservoirs
 - Drains
 - Wetlands
 - Groundwater recharge and pumping
- **Model Output Information:**
 - Groundwater head elevation and drawdown
 - Stream baseflow and groundwater evapotranspiration
 - Groundwater storage
 - Water budget of groundwater system

Framework for IWM Modeling



Application of IWM Modeling

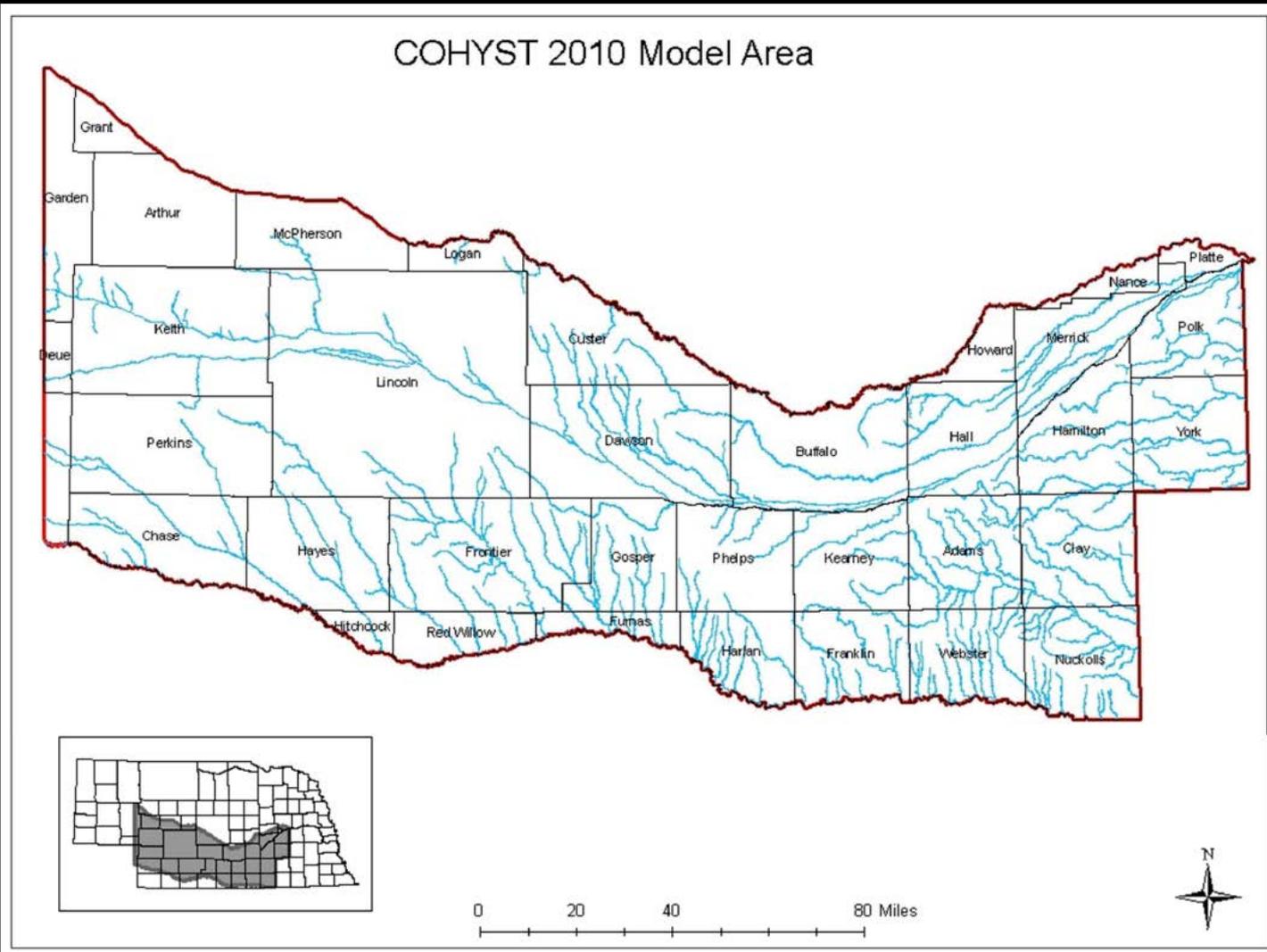


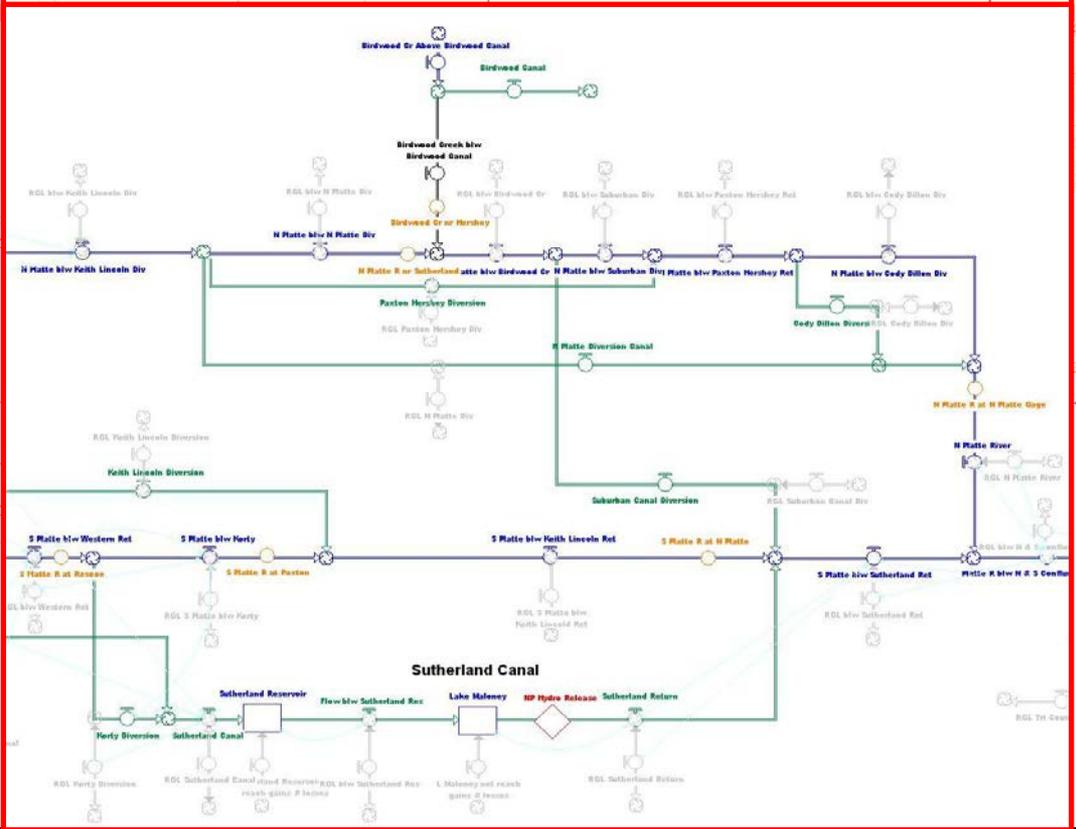
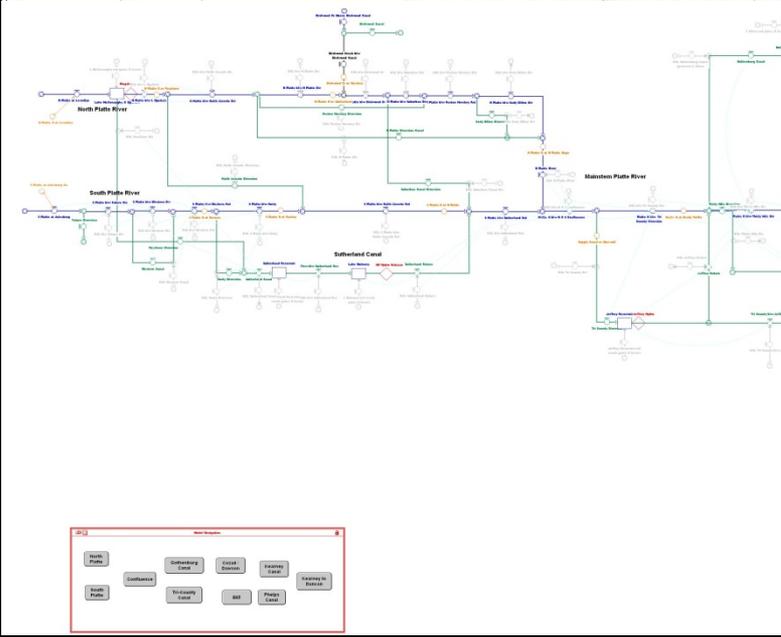
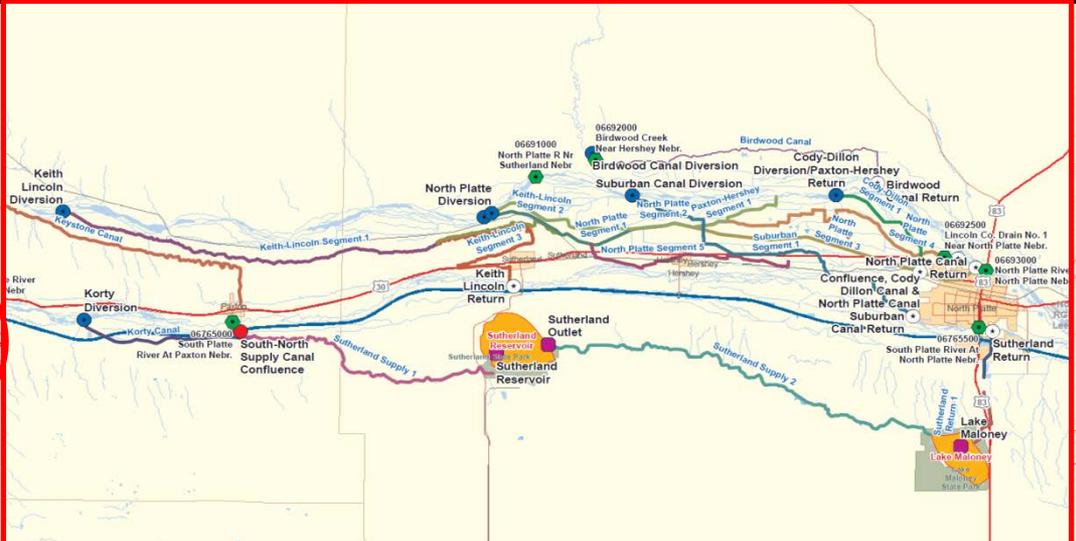
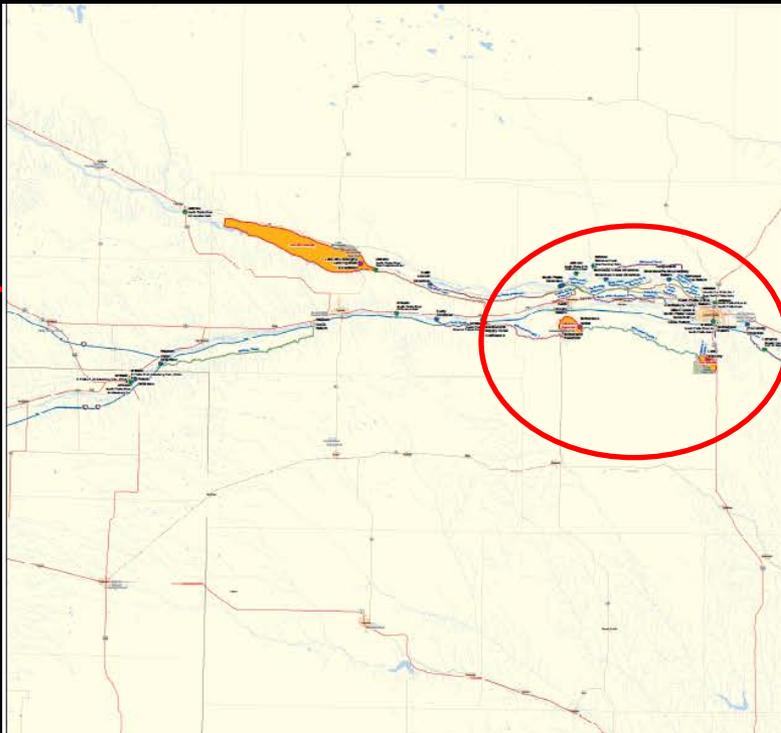
Application of IWM Modeling

COHYST 2010 Integrated Water Management Model

- Model takes into account:
 - Complete water budget
 - Temporal variability
 - Transient flow targets
 - Consumptive use
- Tracking and Accounting
- Capable of management alternatives analysis

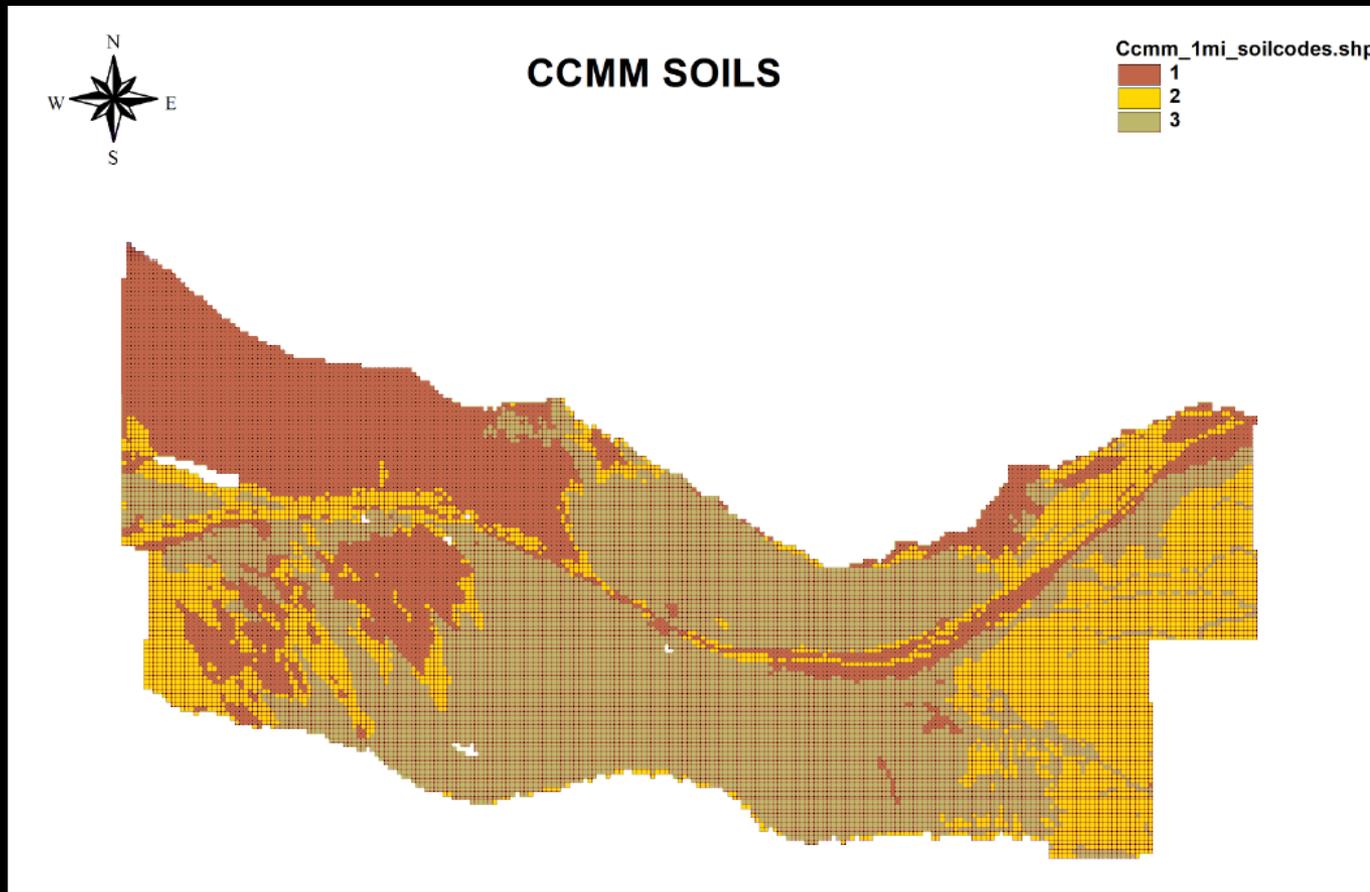
Application of IWM Modeling





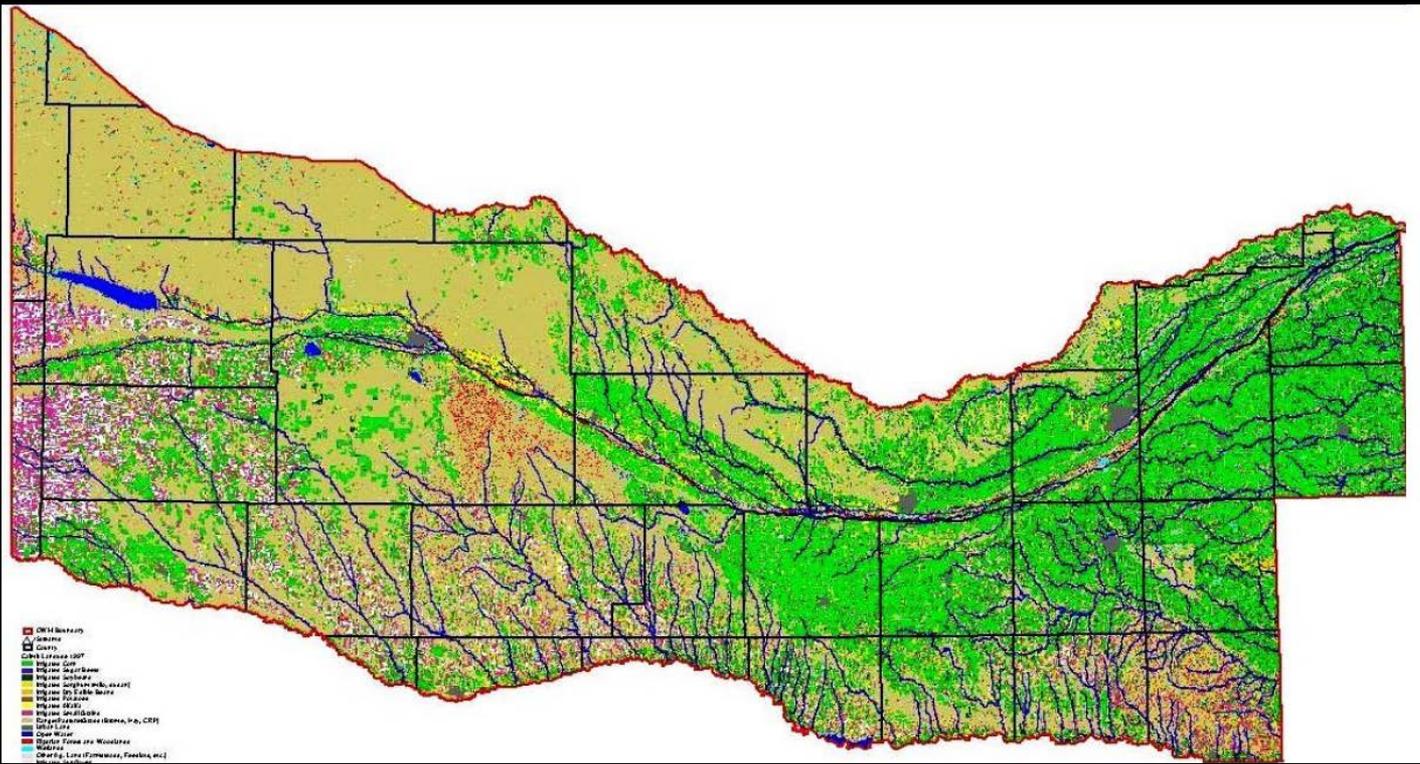
Framework for IWM Modeling

Watershed Model (CROPSIM)



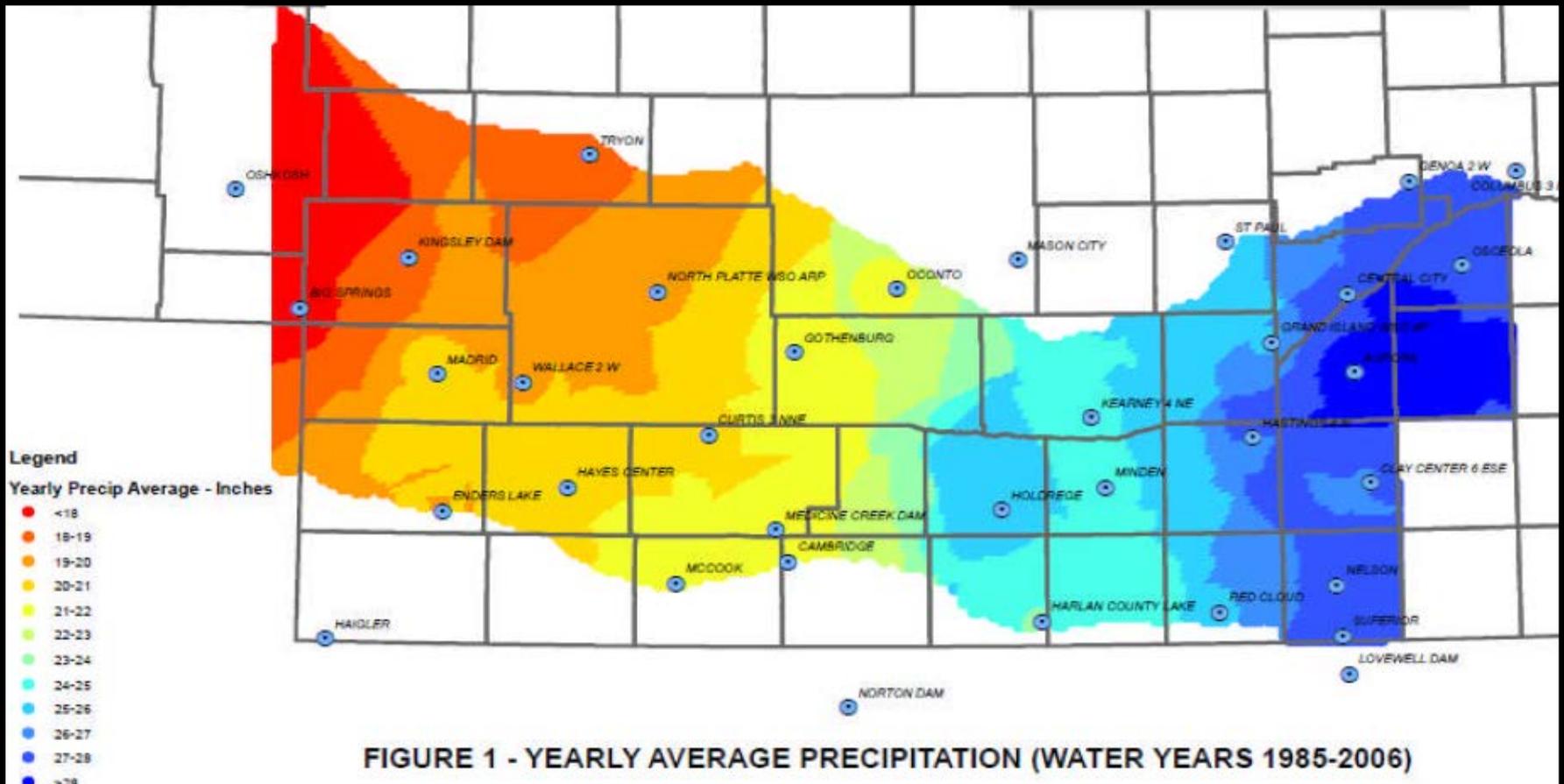
Framework for IWM Modeling

Watershed Model (CROPSIM)



Framework for IWM Modeling

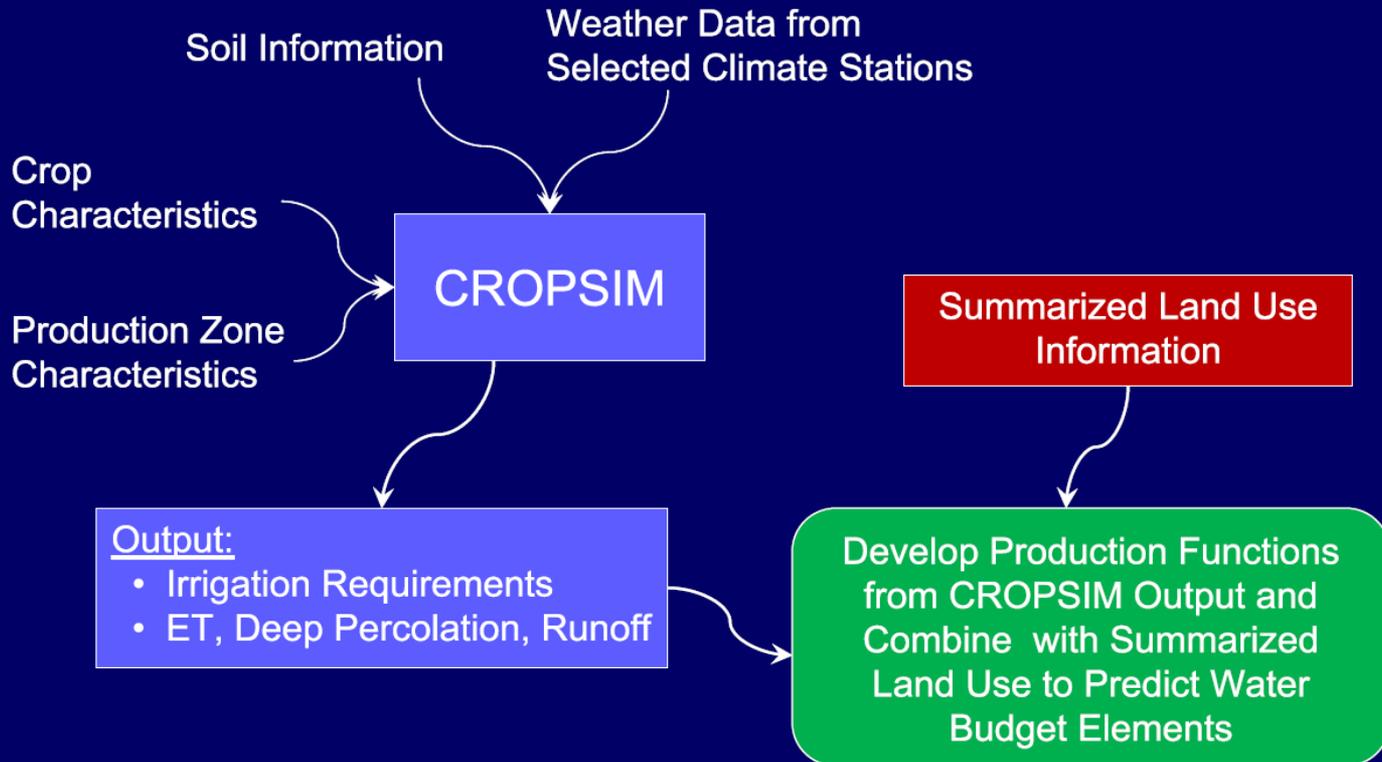
Watershed Model (CROPSIM)



Application of IWM Modeling

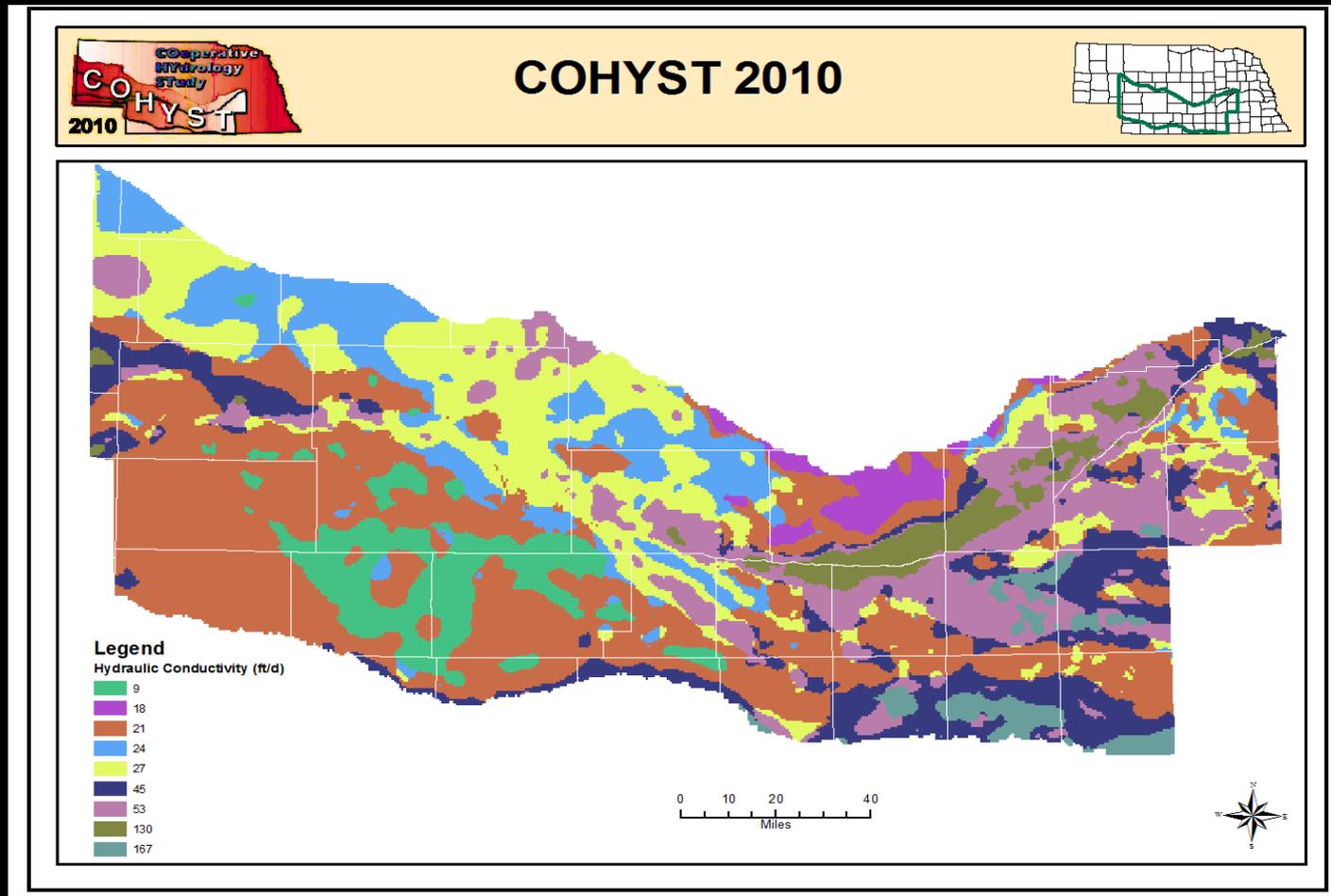
Watershed Model (CROPSIM)

GENERAL APPROACH



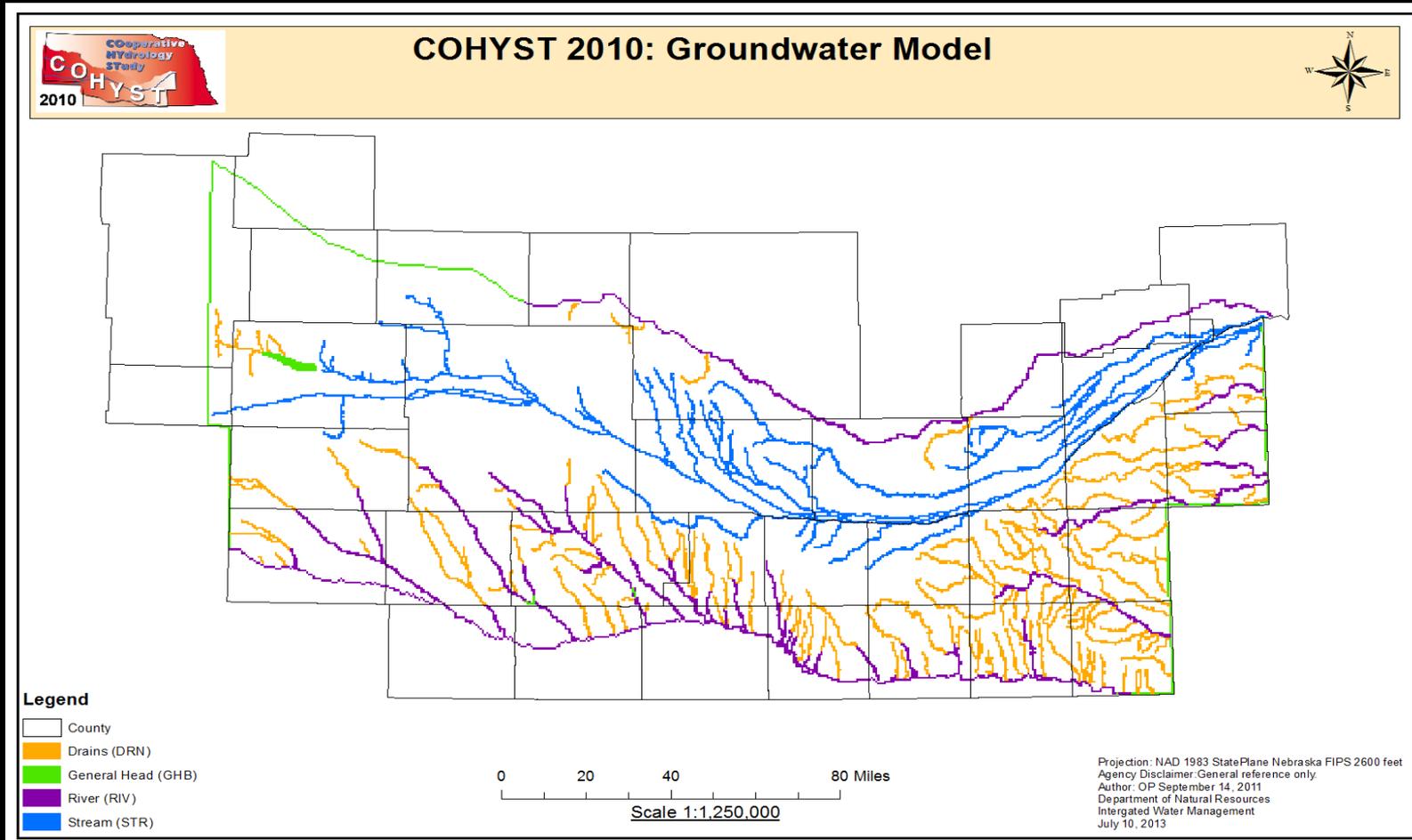
Application of IWM Modeling

Groundwater Model (MODFLOW)



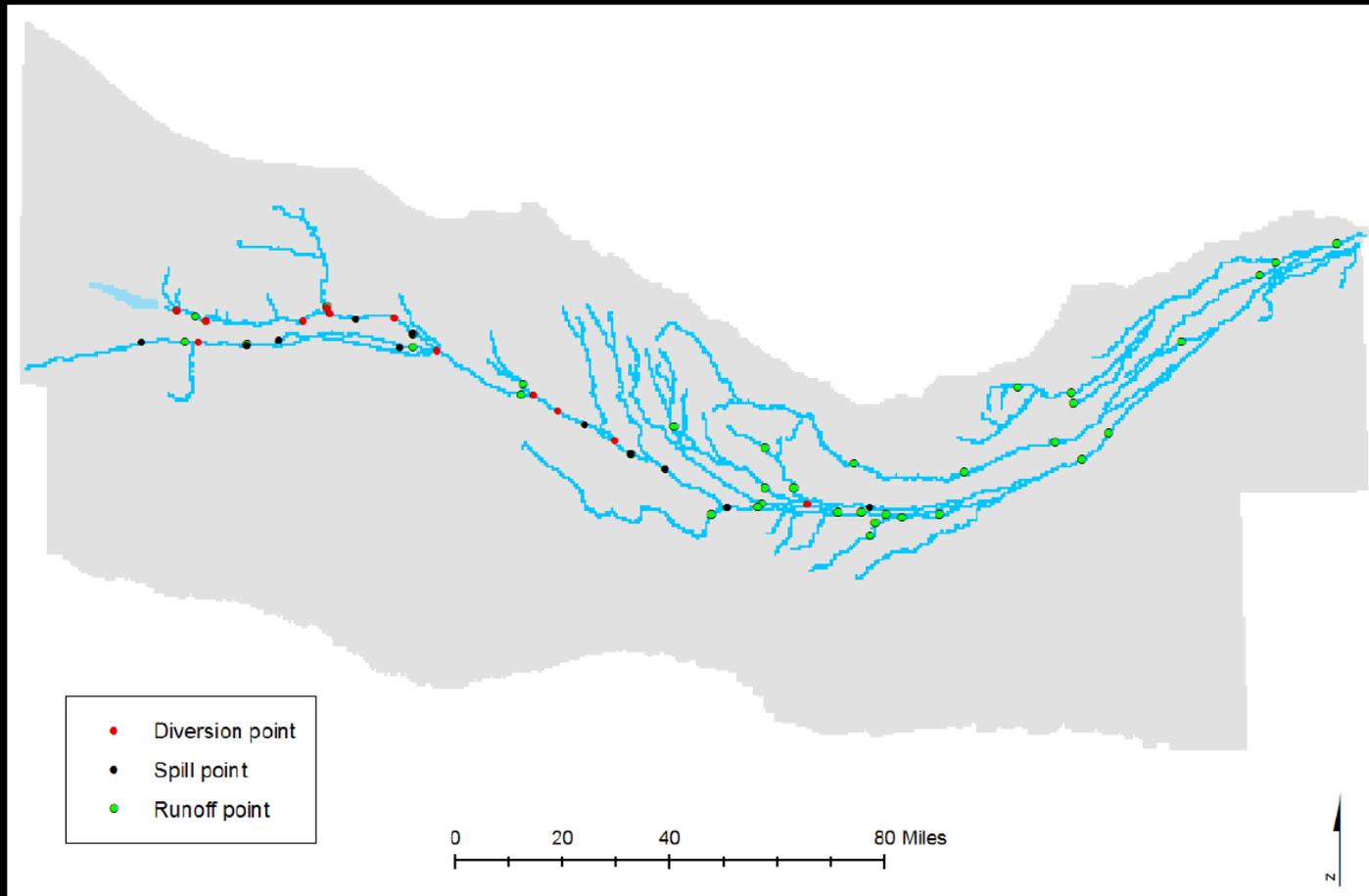
Application of IWM Modeling

Groundwater Model (MODFLOW)

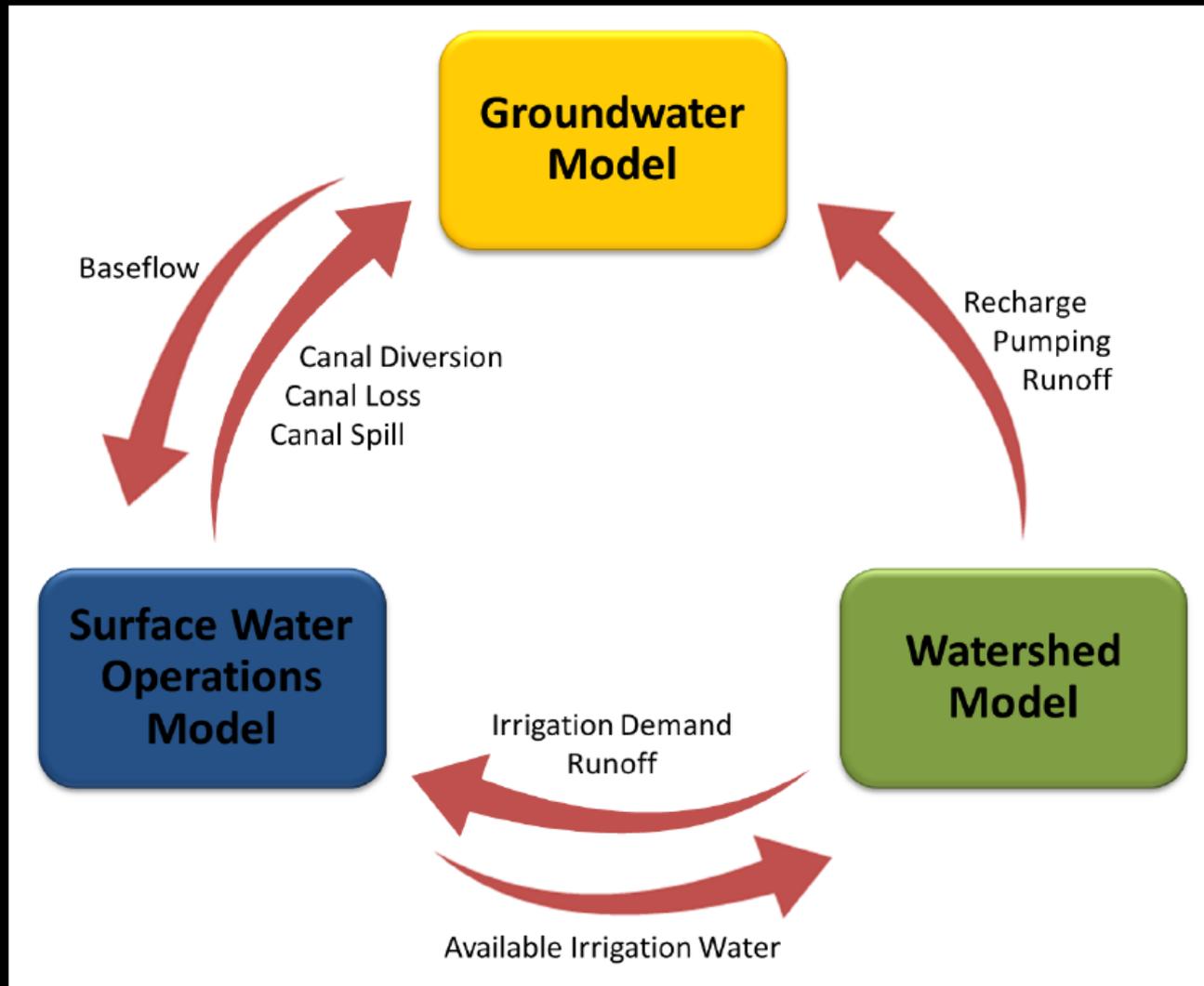


Application of IWM Modeling

Groundwater Model (MODFLOW)

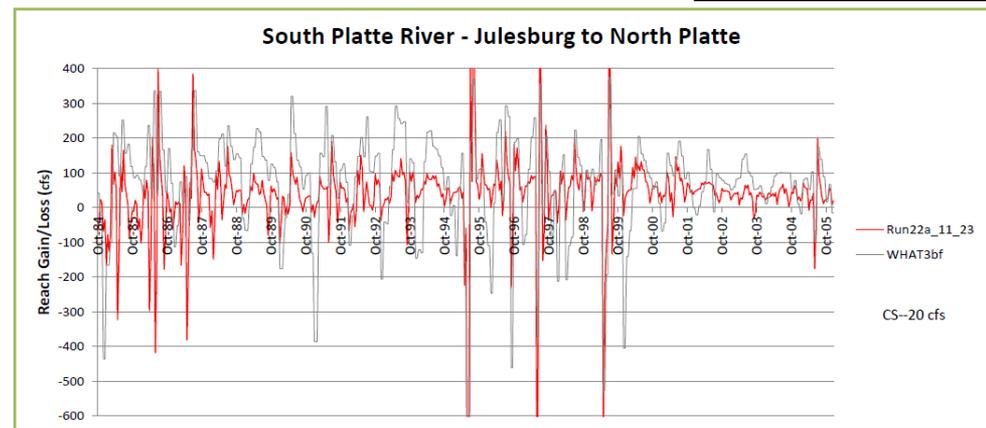
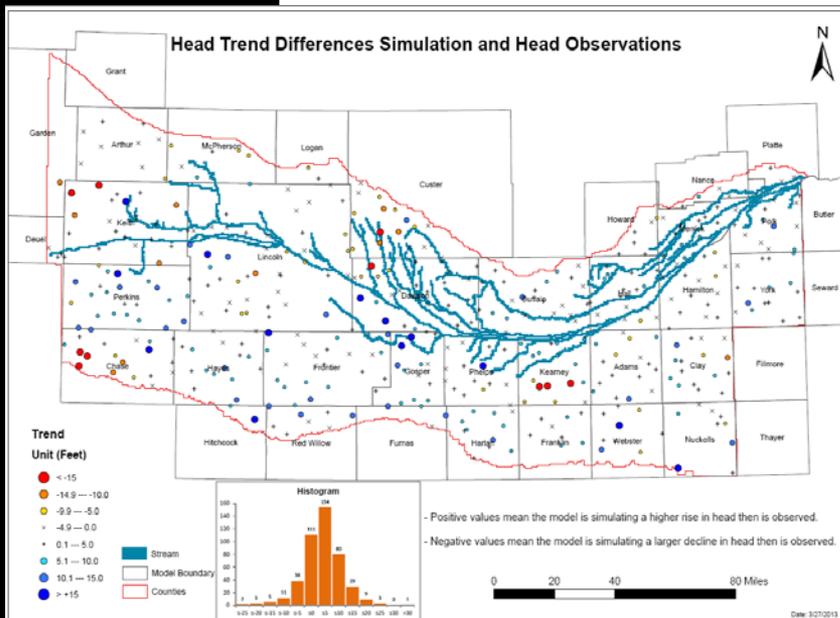


Integration of Models



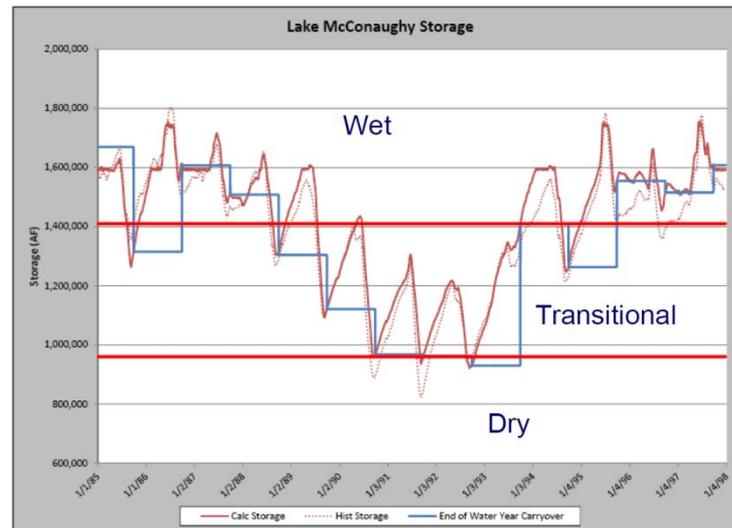
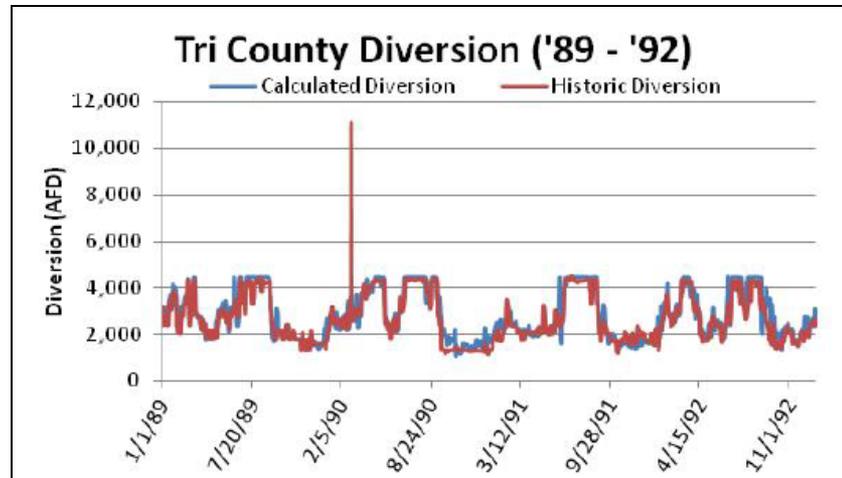
Individual Model Calibration

Groundwater Model



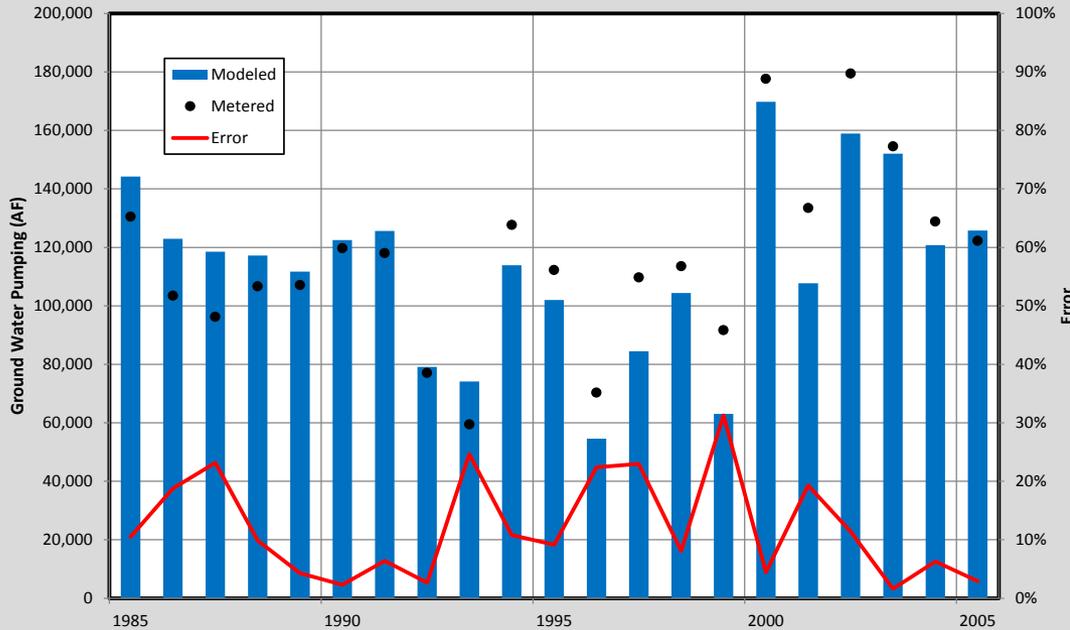
Individual Model Calibration

Surface Water
Operations
Model



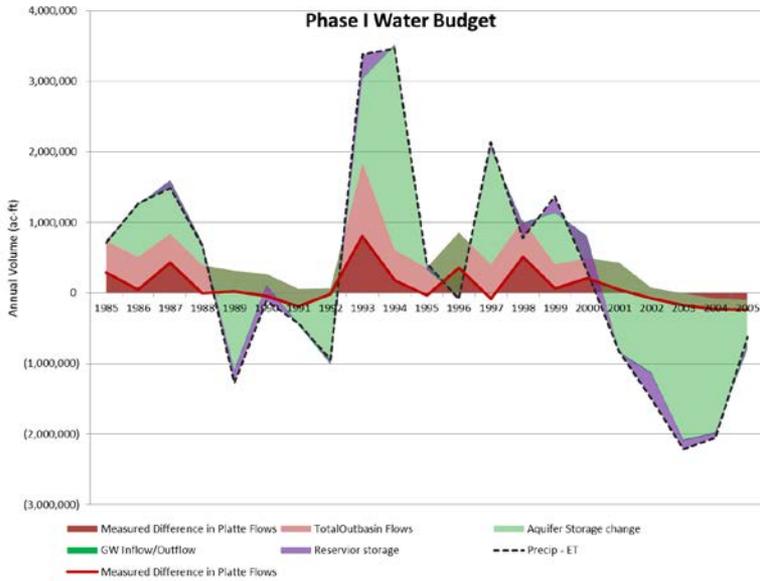
Individual Model Calibration

Modeled Vs Metered Pumping in Perkins County, NE

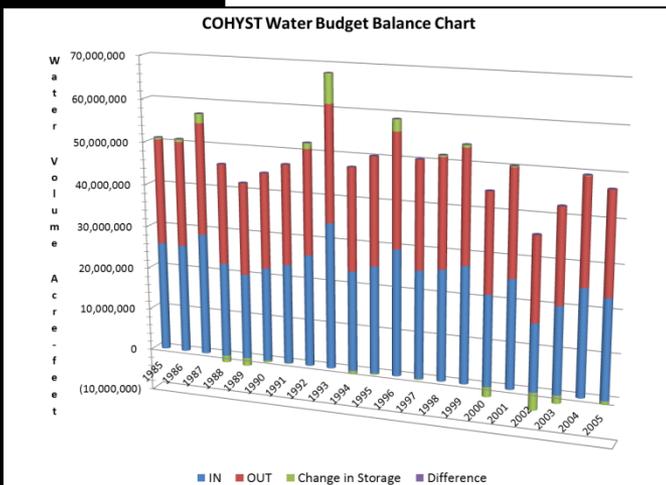
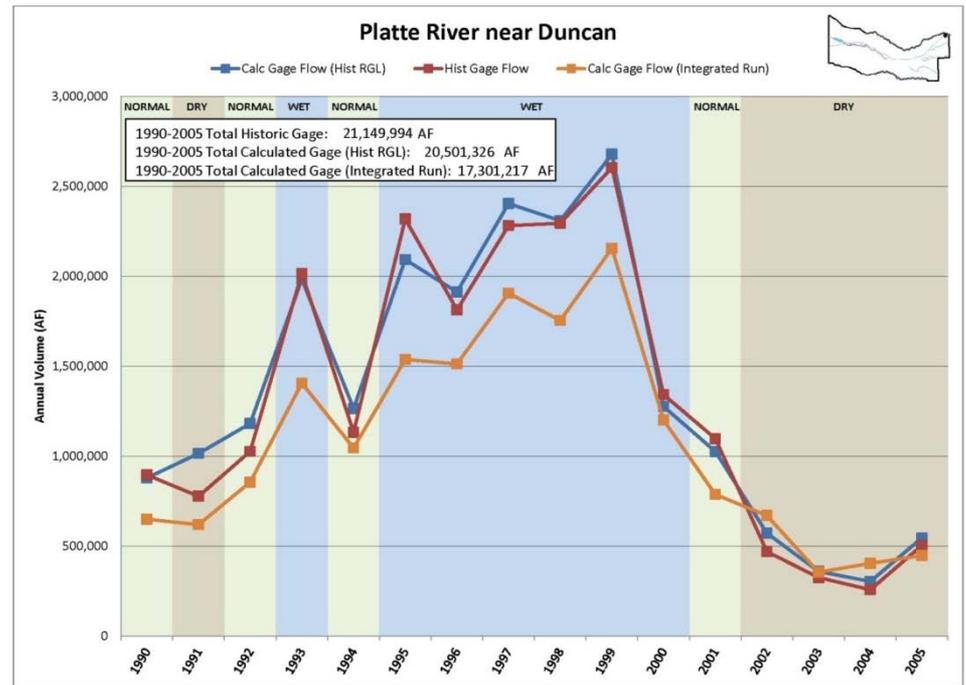


Watershed
Model

Integrated Model Calibration



Groundwater Model



Available Irrigation Water

Summary

- Better understanding of interaction between surface water and groundwater systems is possible with integrated water management model
- Integrated modeling tool development is necessary for effective management of water resources
- Application of Integrated Water Management Model for different management scenarios analysis is required

Any Questions??

Mahesh Pun, EIT
Integrated Water Management Analyst

402-471-3959

Mahesh.pun@nebraska.gov

Nebraska Department of Natural Resources

301 Centennial Mall S. – 4th Floor

Lincoln, NE 68509-4676

