Integrated Water Management Modeling for Adaptive Management of Groundwater Systems in Nebraska

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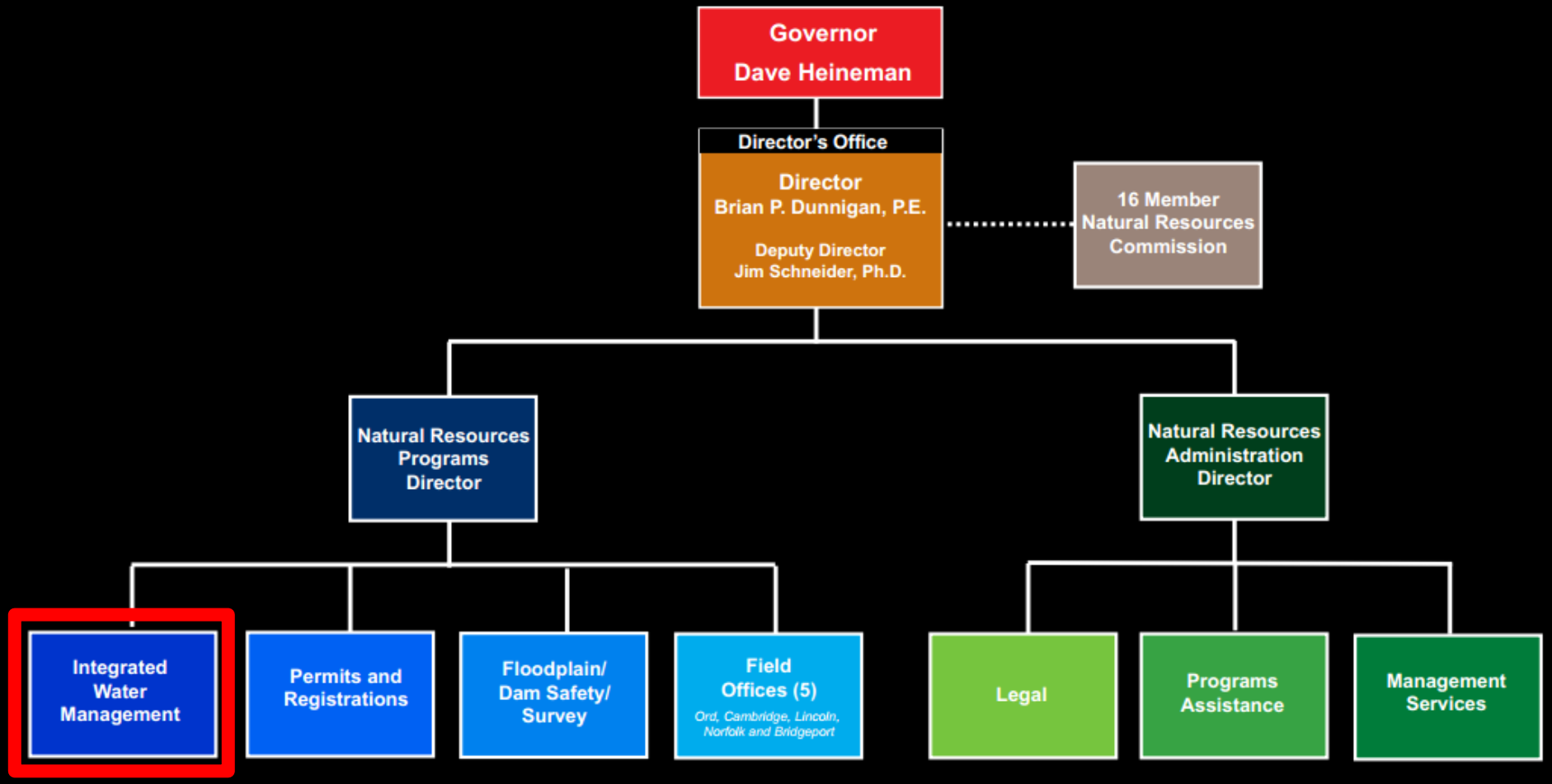
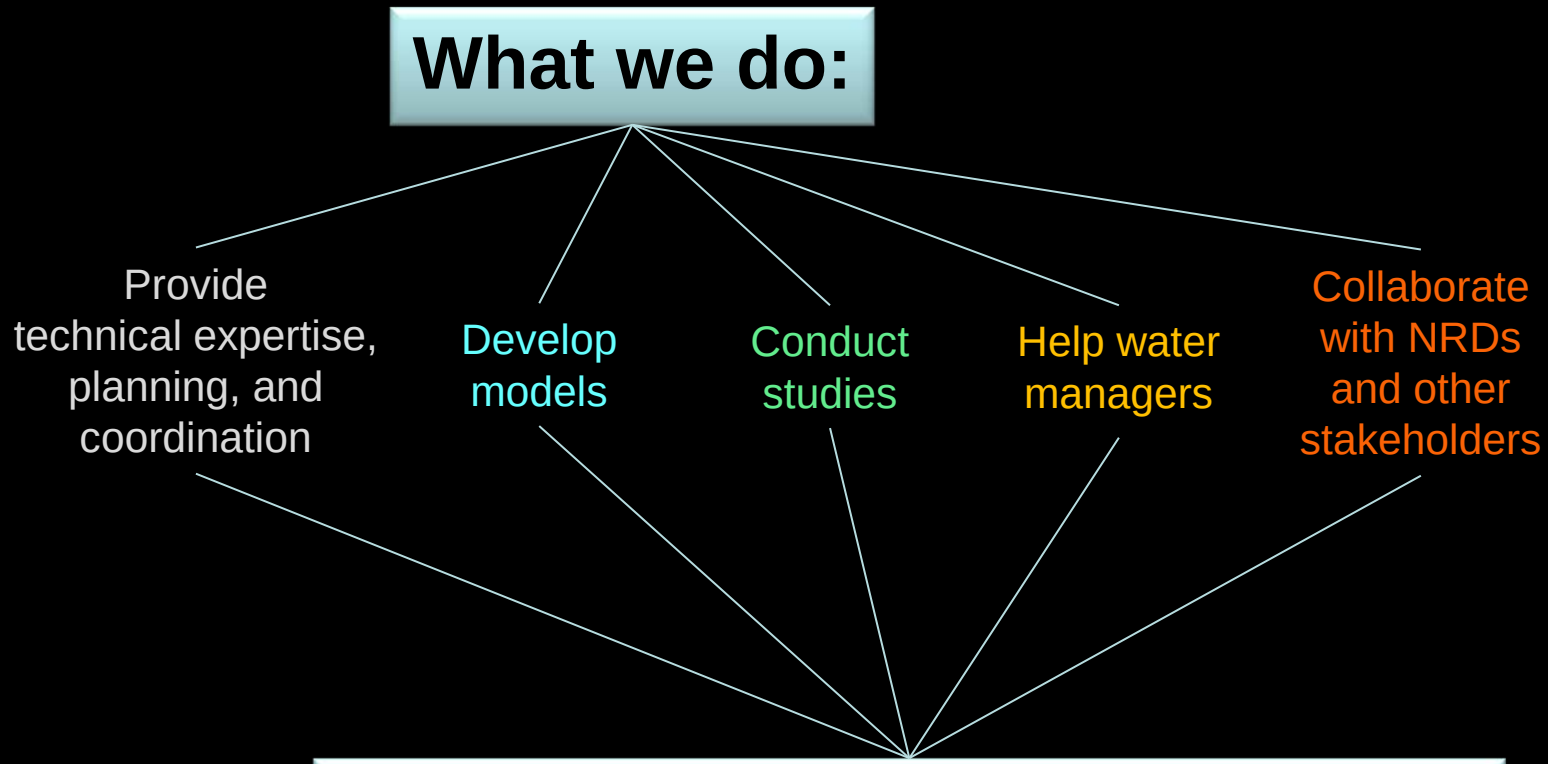


Nebraska Department of Natural Resources

Integrated Water Management Division



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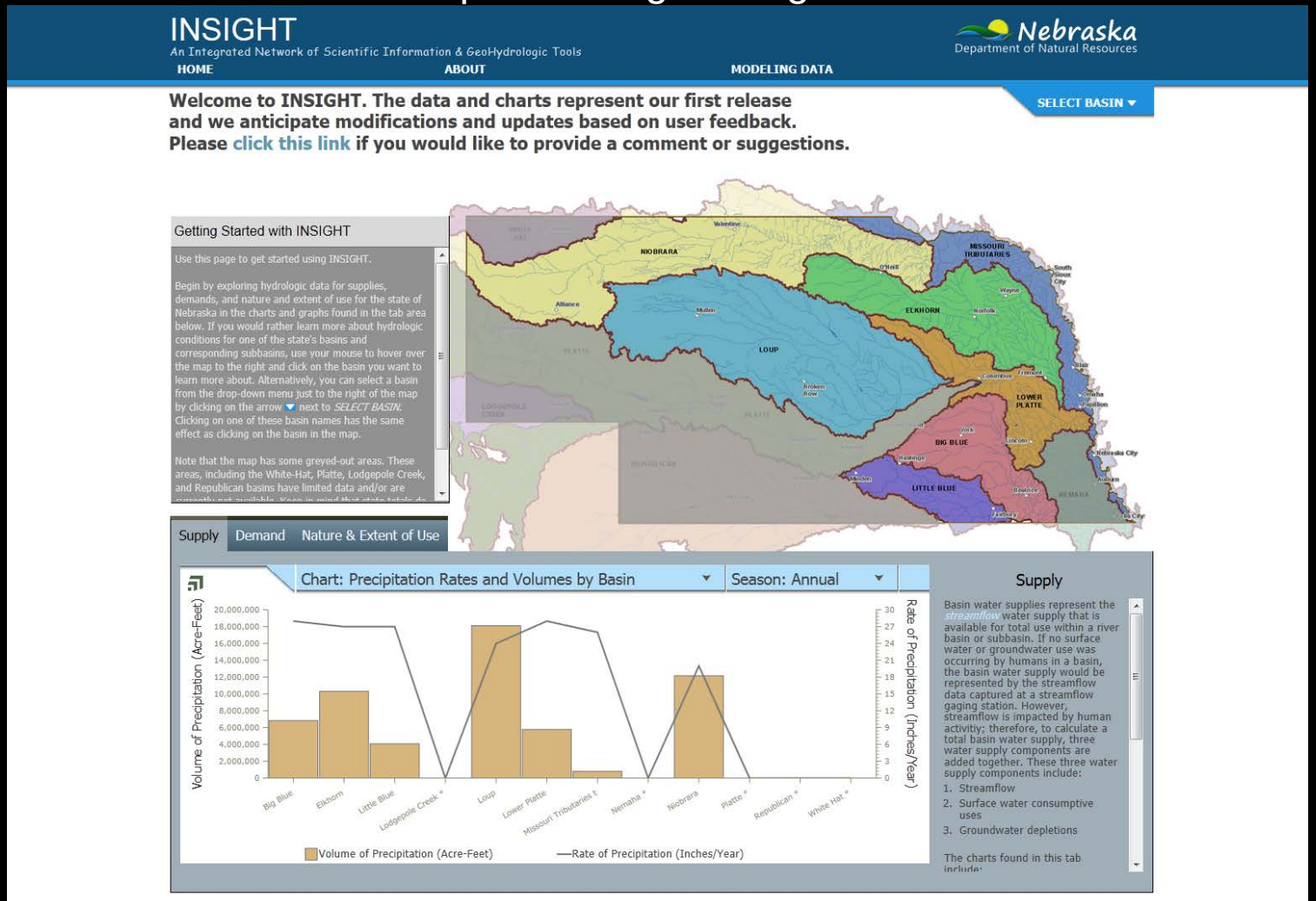
http://dnr.ne.gov/insight/



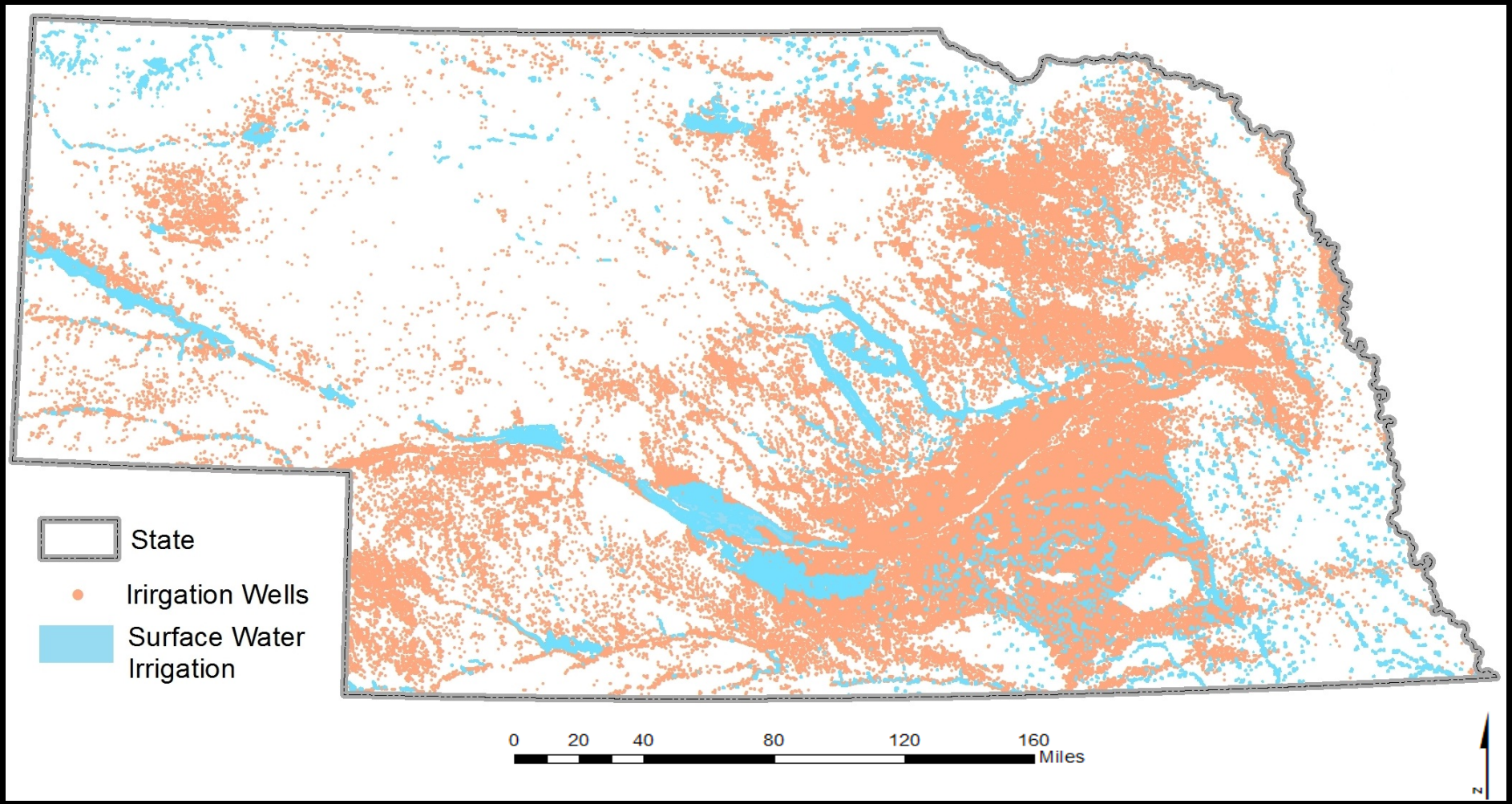
Introduction and Background

- 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

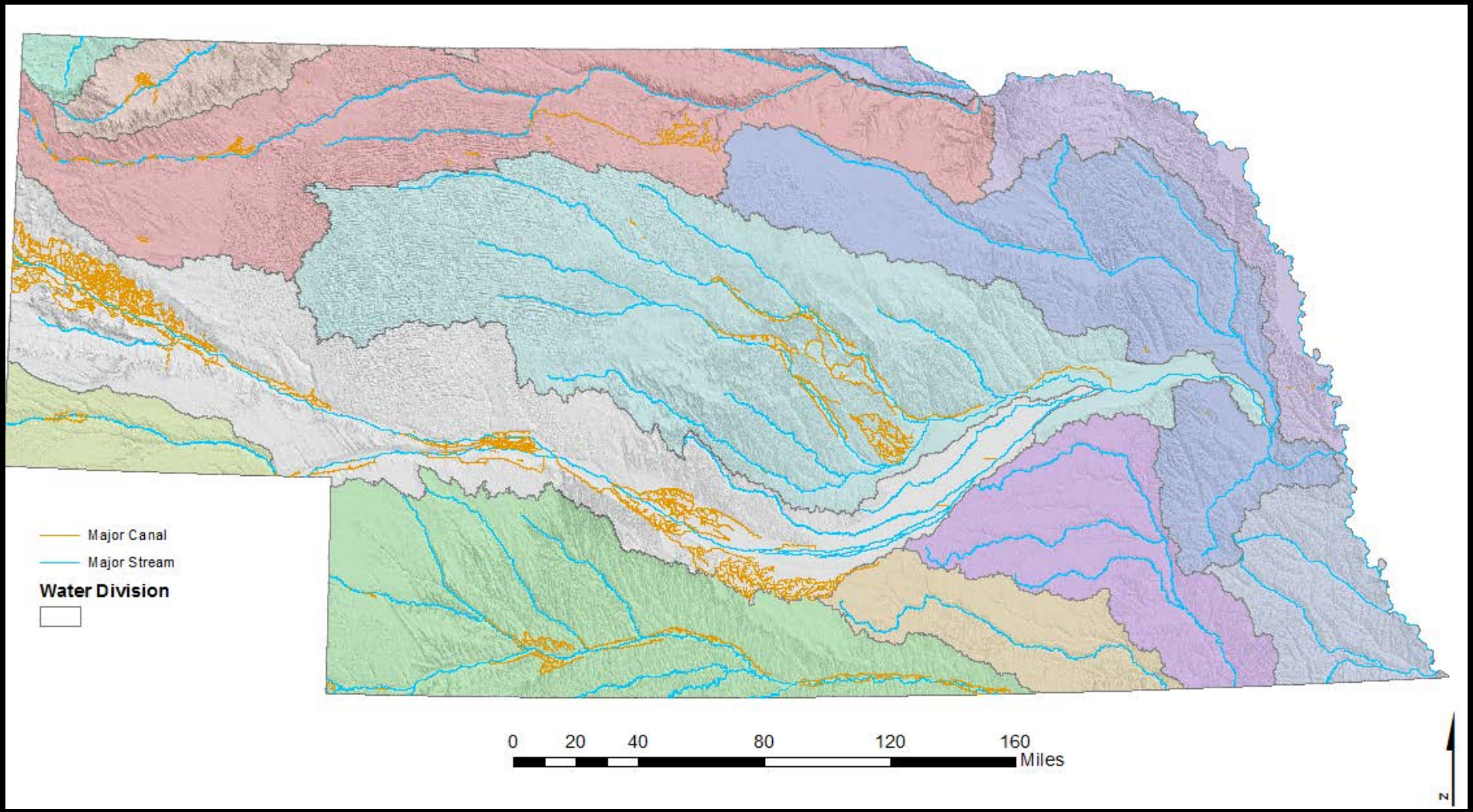
Introduction and Background

- 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
- Full water-budget tracking of water management strategies prior to implementation

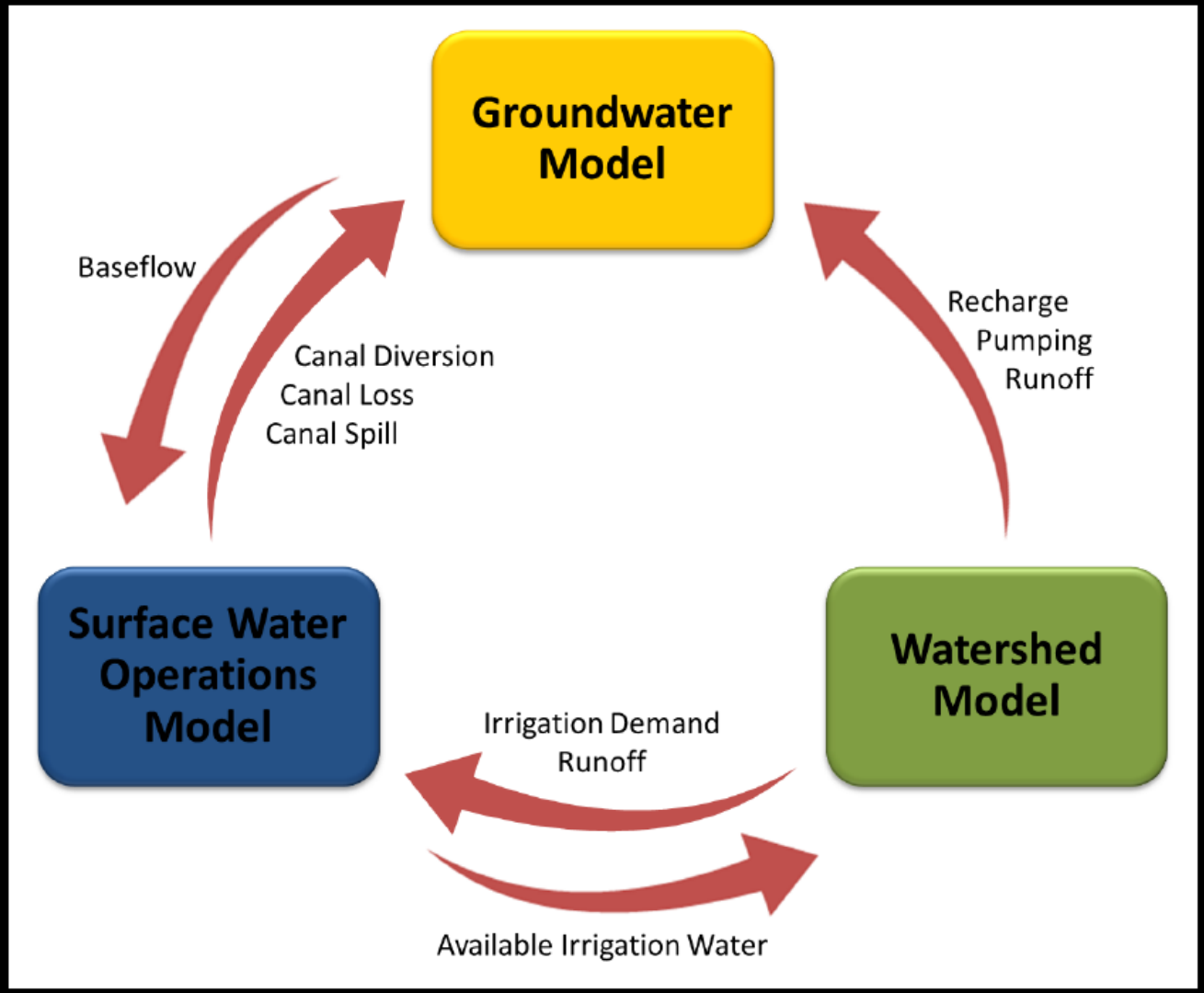
Introduction and Background



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

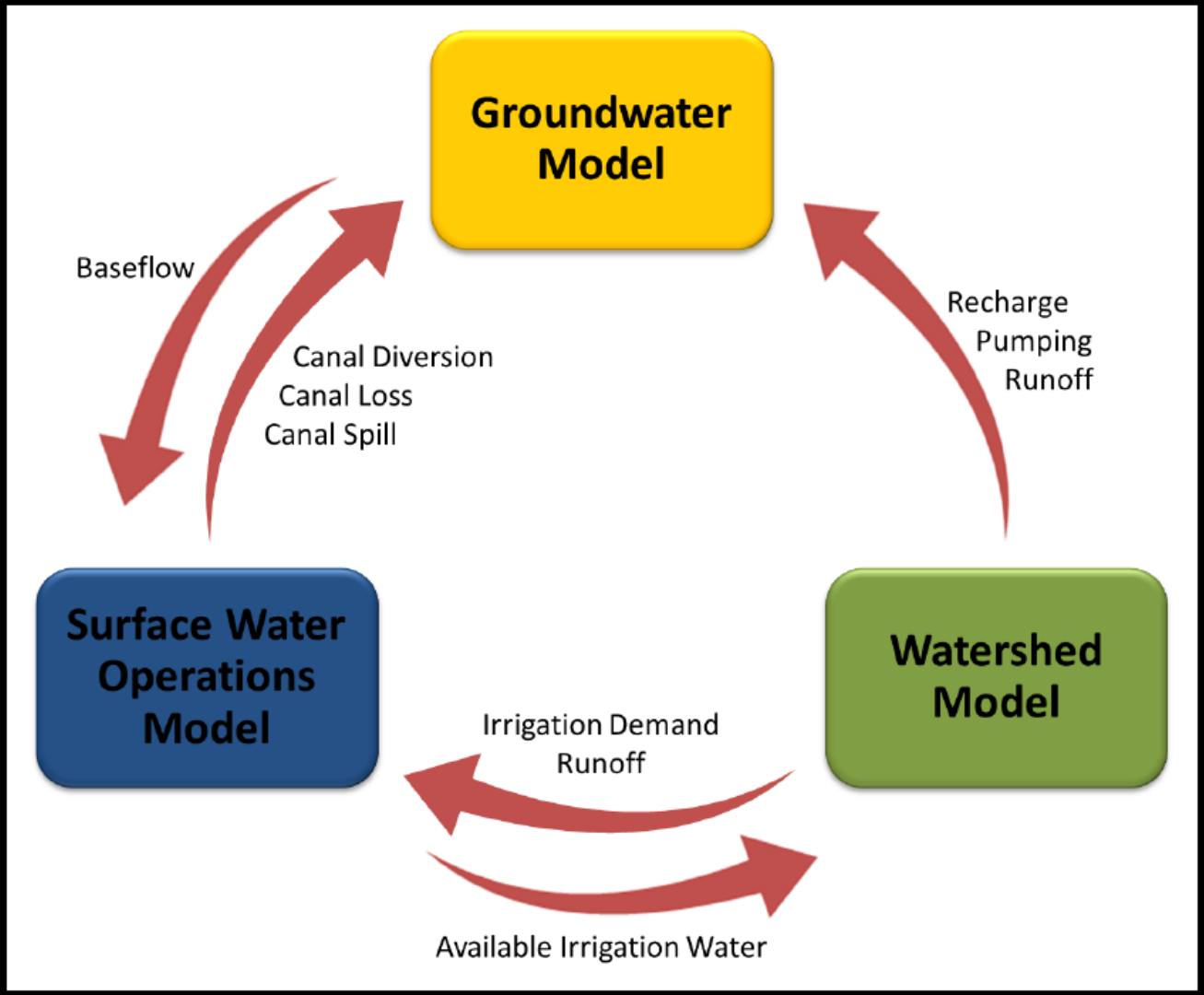
Framework for IWM Modeling

Groundwater Model

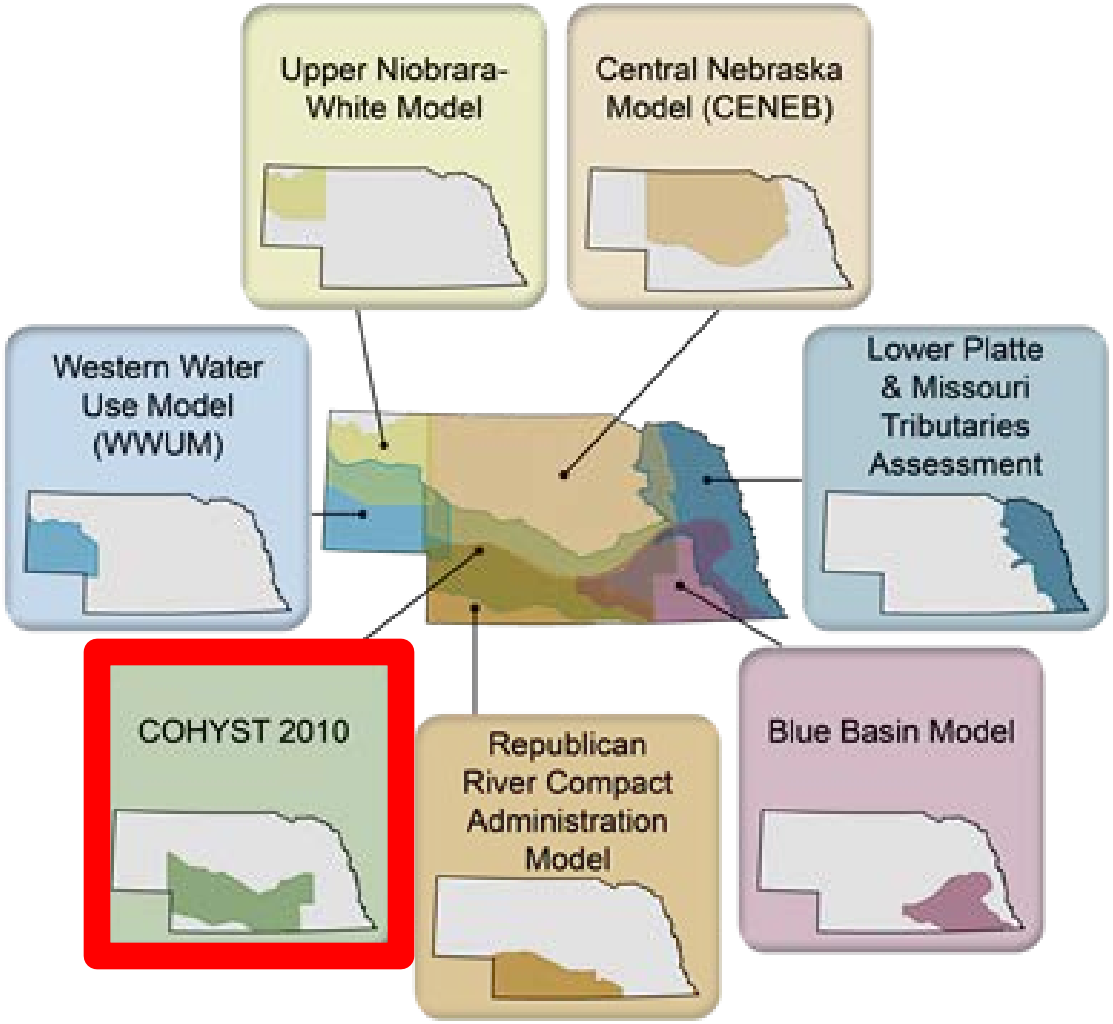
- **Model Input Consideration:**
  - Aquifer properties
  - Streams and reservoirs
  - Drains
  - Wetlands
  - Groundwater recharge and pumping

- **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

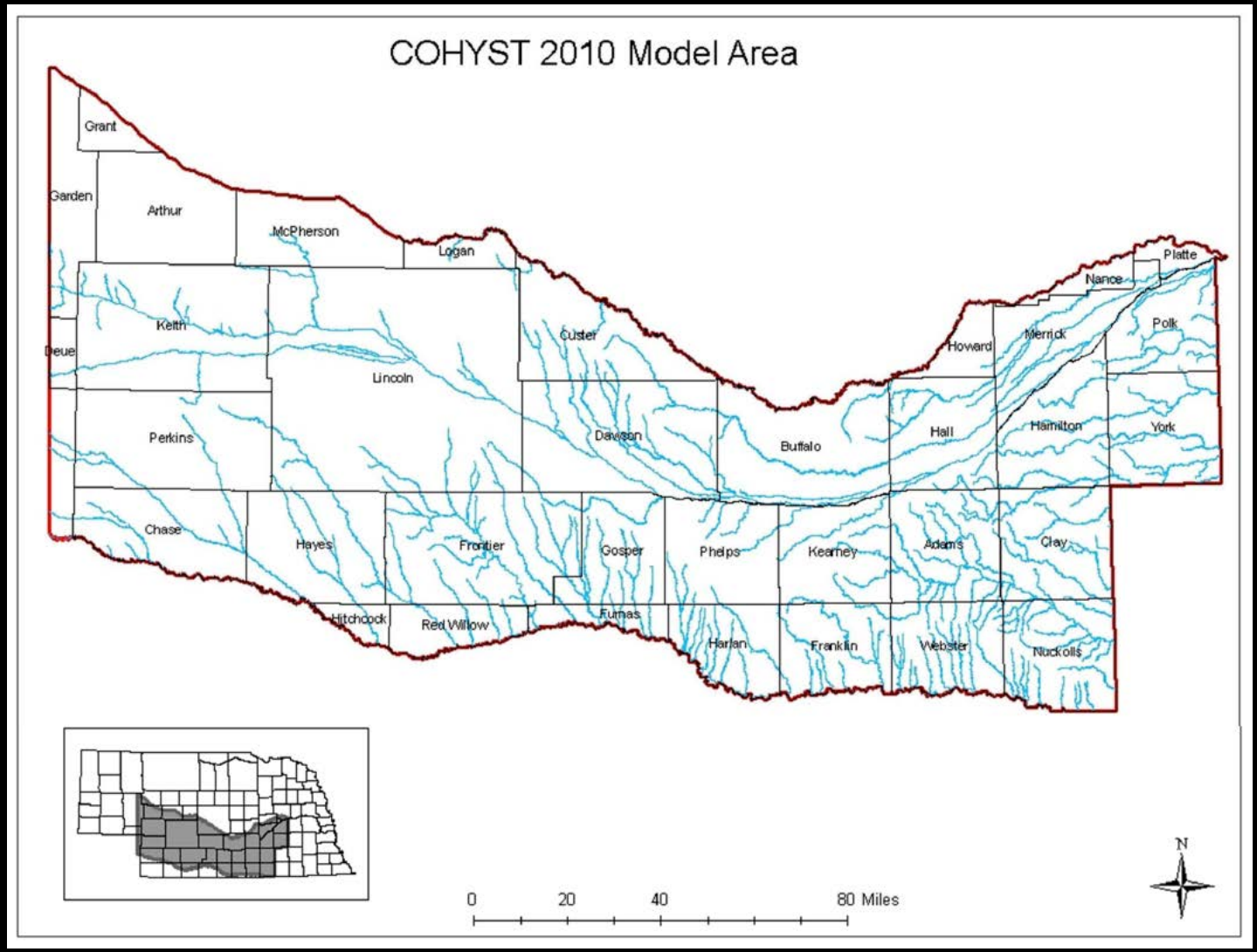


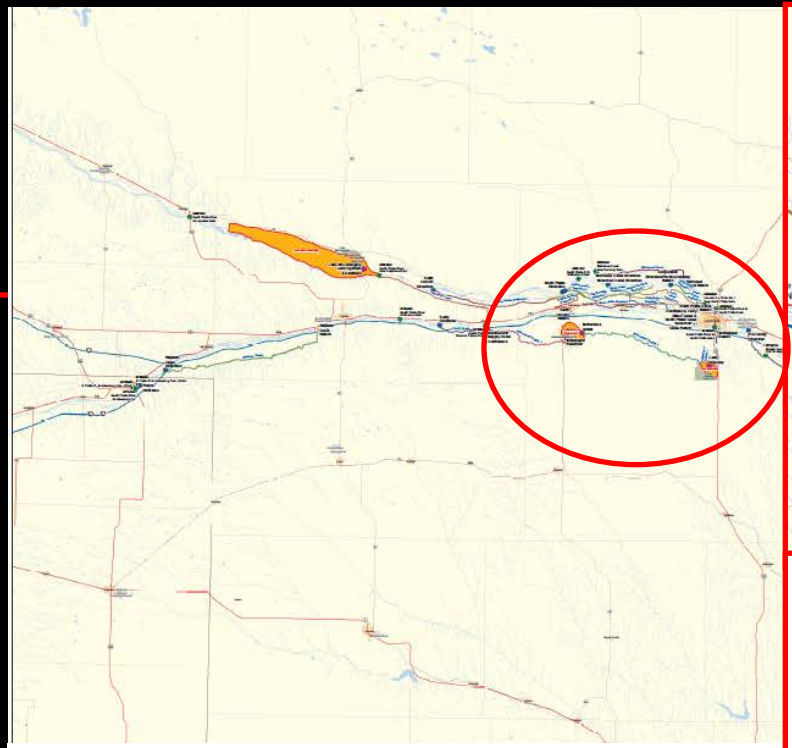
Application of IWM Modeling

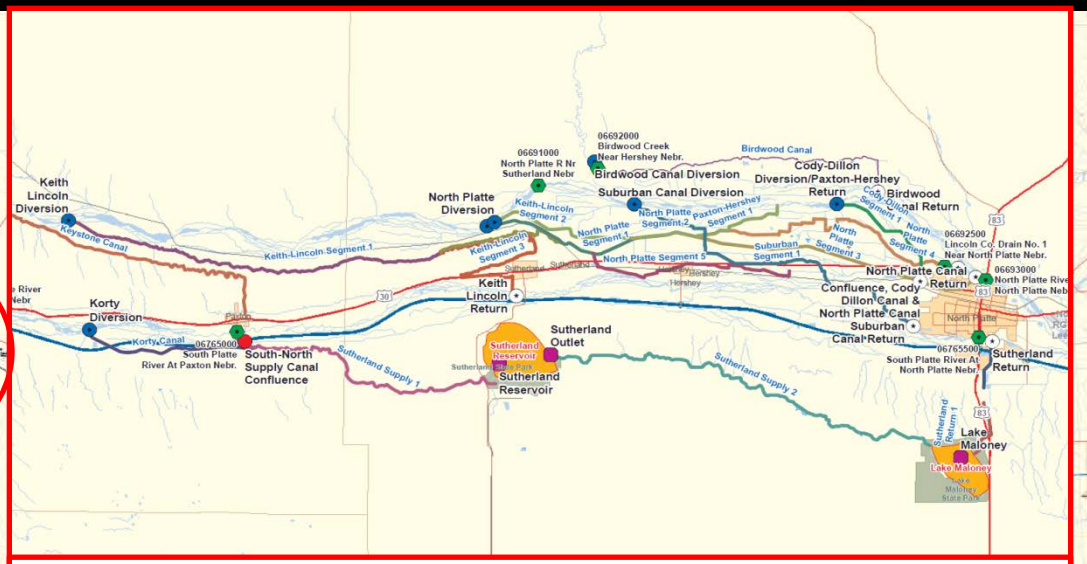
COHYST 2010 Integrated Water Management Model

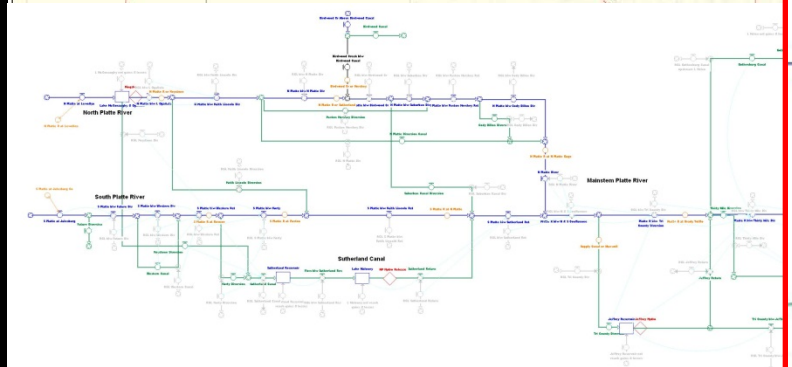
- Model takes into account:
  - Complete water budget
  - Temporal variability
  - Transient flow targets
  - Consumptive use
- Tracking and Accounting
- Capable of management alternatives analysis

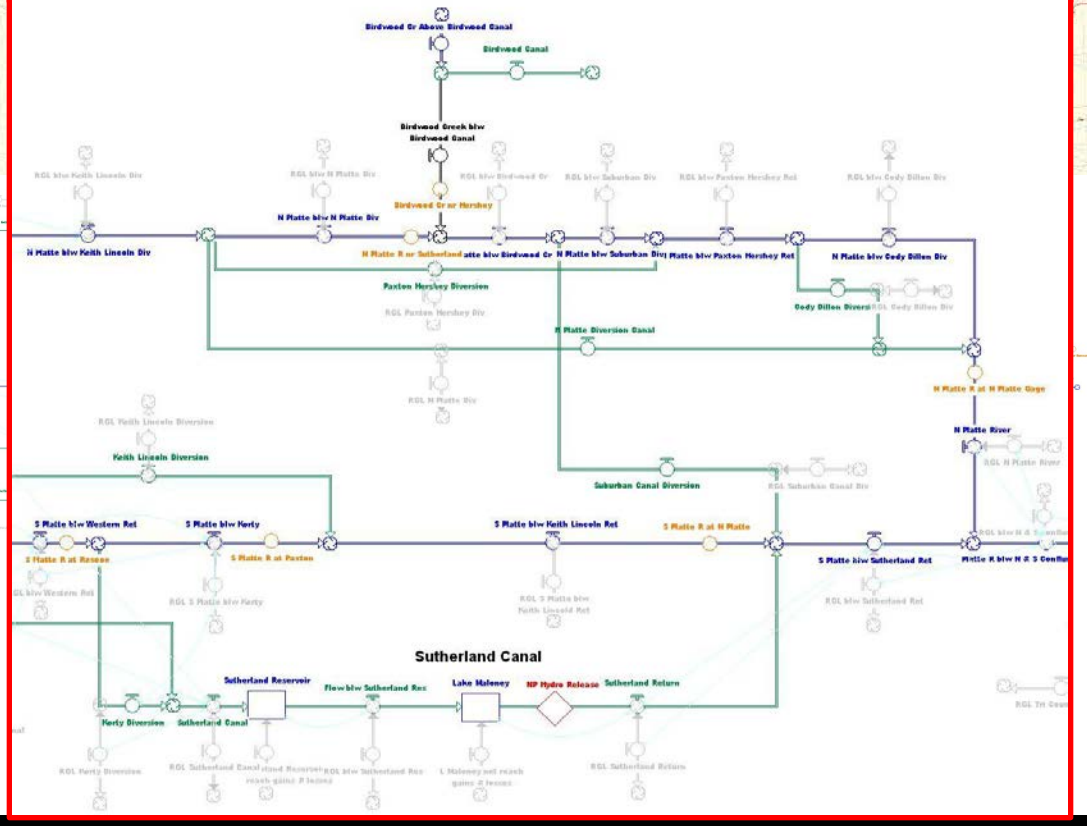
Application of IWM Modeling

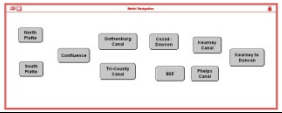





Keith Lincoln Diversion
Keystone Canal
North Platte Diversion
06691000 North Platte R Nr Sutherland Nebr
06692000 Birdwood Creek Near Hershey Nebr.
Birdwood Canal Diversion
Birdwood Canal
Suburban Canal Diversion
Cody-Dillon Diversion/Paxton-Hershey Return
Birdwood Canal Return
Keith-Lincoln Segment 1
Keith-Lincoln Segment 2
Keith-Lincoln Segment 3
North Platte Segment 1
North Platte Segment 2
Paxton-Hershey Segment 1
Cody-Dillon Segment 1
North Platte Segment 3
North Platte Segment 4
Suburban Segment 1
North Platte Segment 5
06692500 Lincoln Co. Drain No. 1 Near North Platte Nebr.
06693000 North Platte River At North Platte Nebr.
North Platte Canal Return
Confluence, Cody Dillon Canal & North Platte Canal Suburban Canal Return
Keith Lincoln Return
Korty Diversion
Korty Canal
06765000 South Platte River At Paxton Nebr.
South-North Supply Canal Confluence
Sutherland Outlet
Sutherland Reservoir
Sutherland Supply 1
Sutherland Supply 2
06765500 South Platte River At North Platte Nebr.
Sutherland Return
Sutherland Return 1
Lake Maloney
Lake Maloney State Park

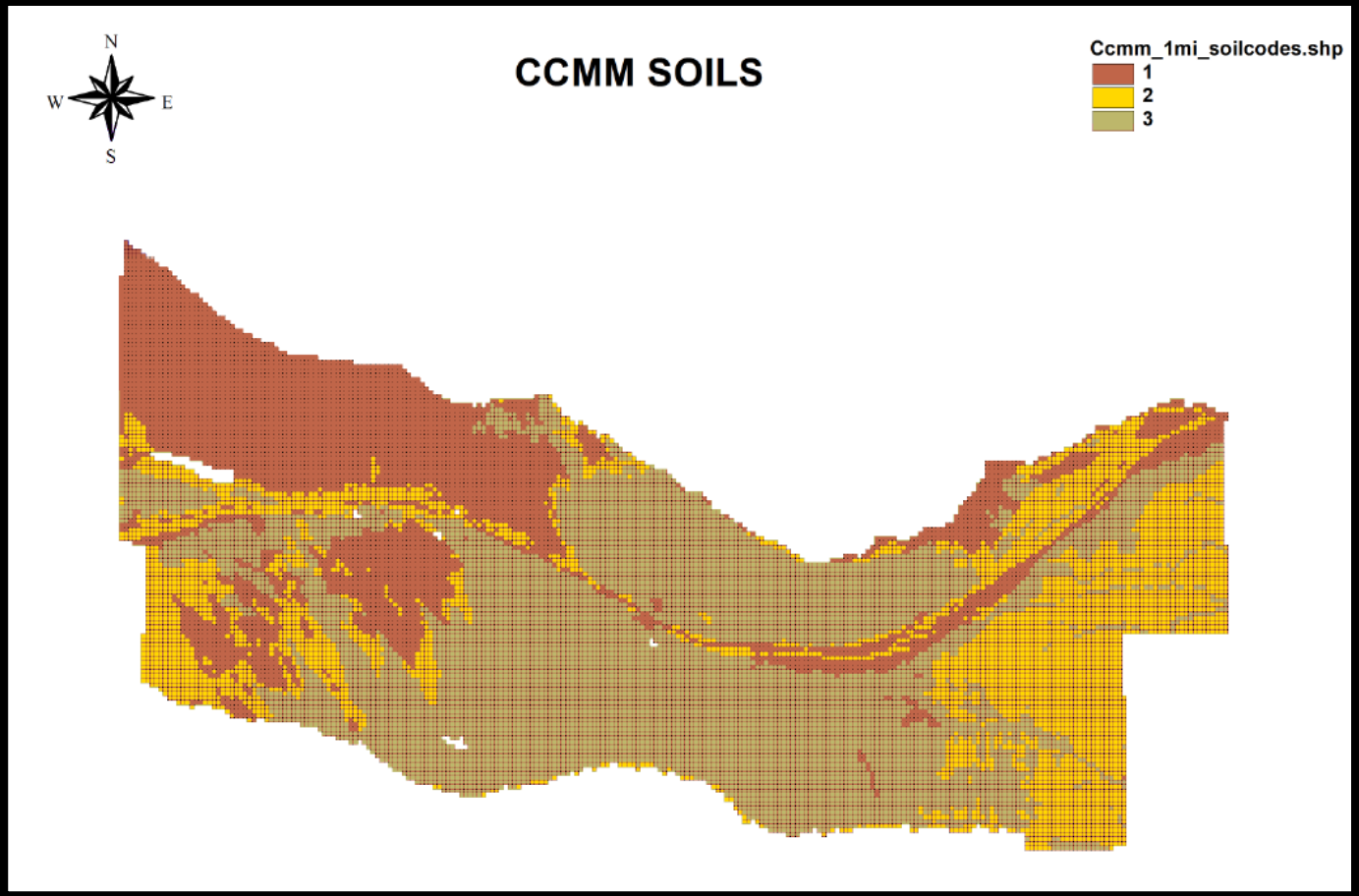

North Platte River
South Platte River
Mainstem Platte River
Sutherland Canal


Birdwood Cr Above Birdwood Canal
Birdwood Canal
Birdwood Creek blw Birdwood Canal
Birdwood Cr nr Hershey
N Platte blw N Platte Div
N Platte blw Keith Lincoln Div
N Platte R nr Sutherland
atte blw Birdwood Cr
N Platte blw Suburban Div
Platte blw Paxton Hershey Rel
N Platte blw Cody Dillon Div
Paxton Hershey Diversion
Cody Dillon Divers
N Platte Diversion Canal
N Platte R at N Platte Gage
N Platte River
Keith Lincoln Diversion
Suburban Canal Diversion
S Platte blw Western Rel
S Platte blw Horty
S Platte blw Keith Lincoln Rel
S Platte R at N Platte
S Platte R at Roscoe
S Platte R at Paxton
S Platte blw Sutherland Rel
Platte R blw N & S Confluence
Sutherland Canal
Sutherland Reservoir
Flow blw Sutherland Res
Lake Maloney
NP Hydro Release
Sutherland Return
Horty Diversion
Sutherland Canal



Framework for IWM Modeling

Watershed Model (CROPSIM)



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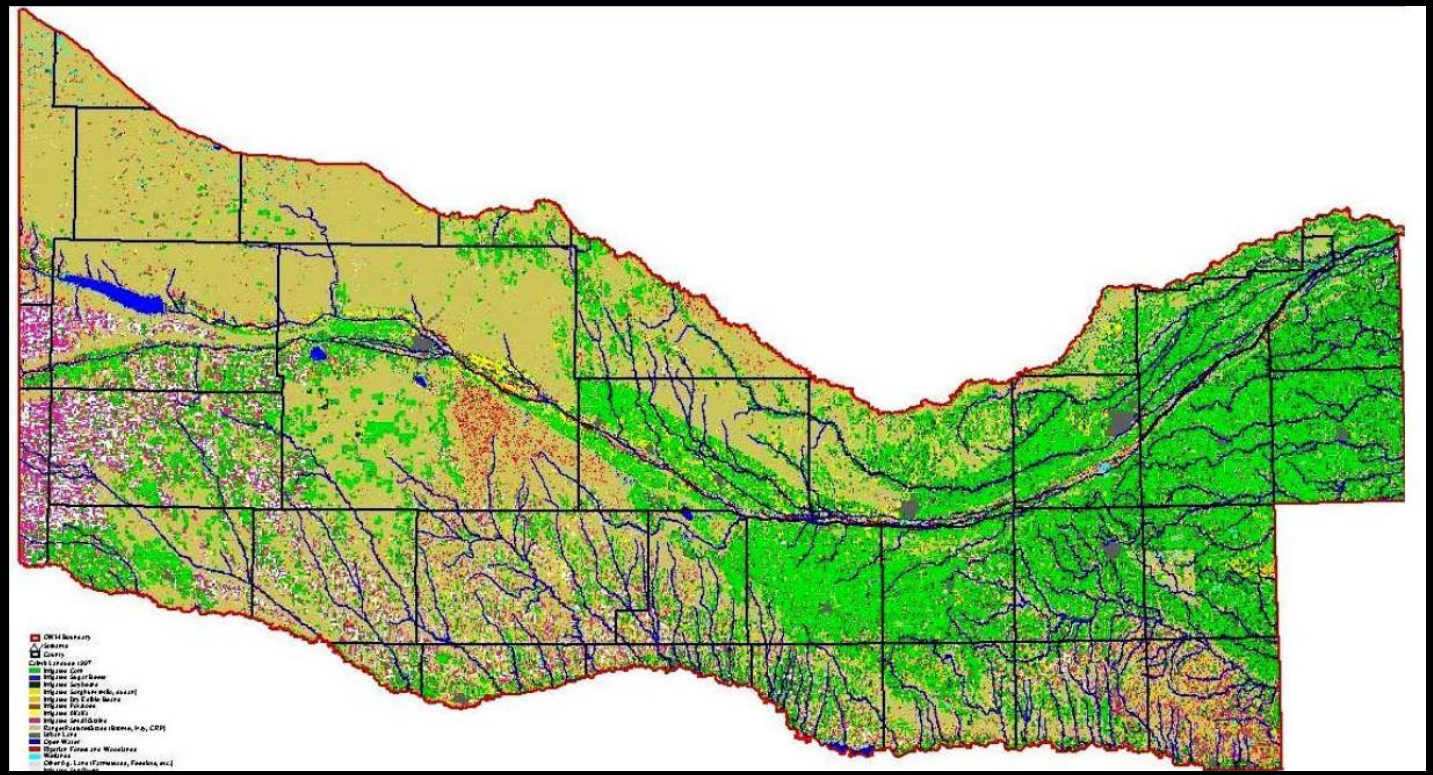

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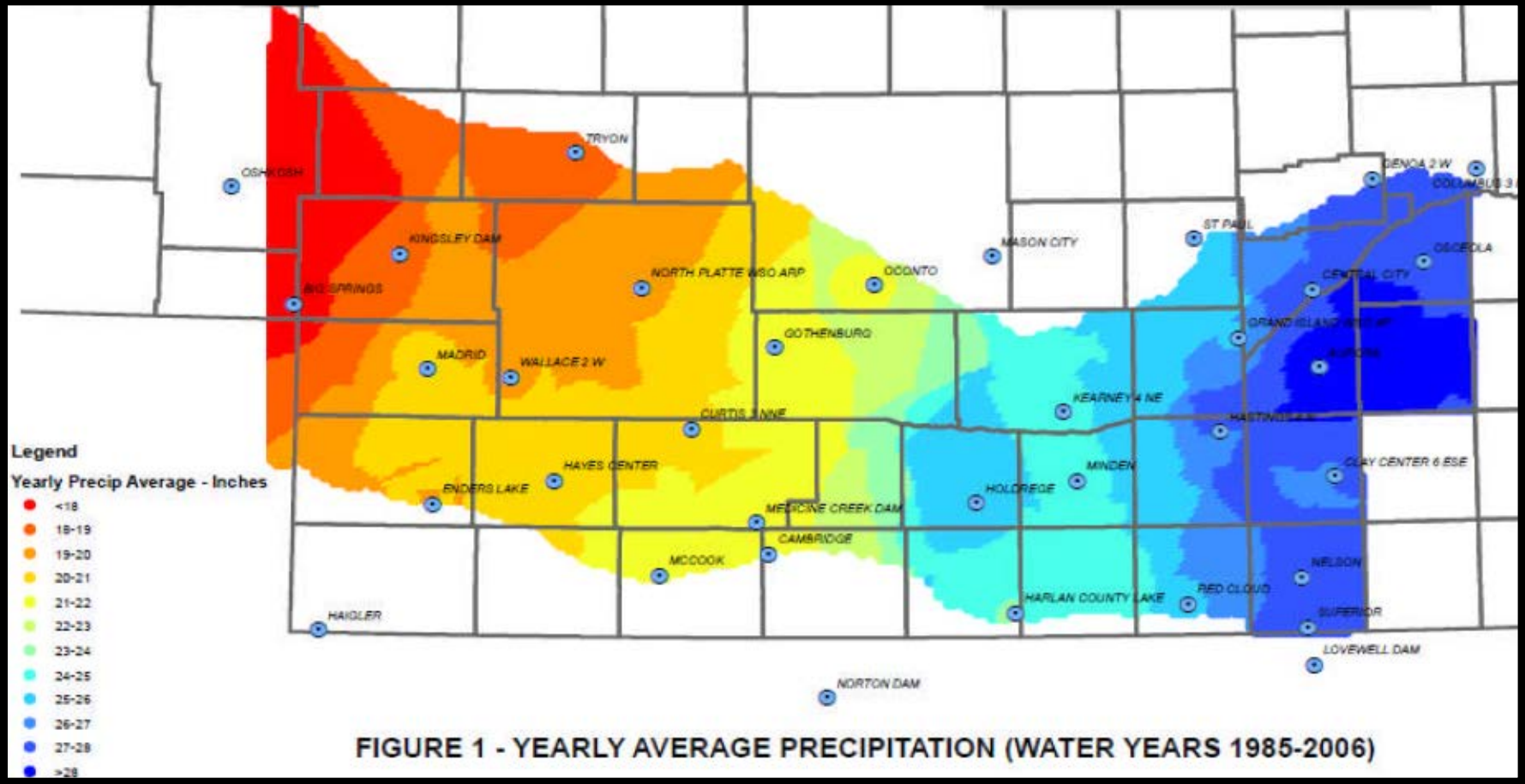
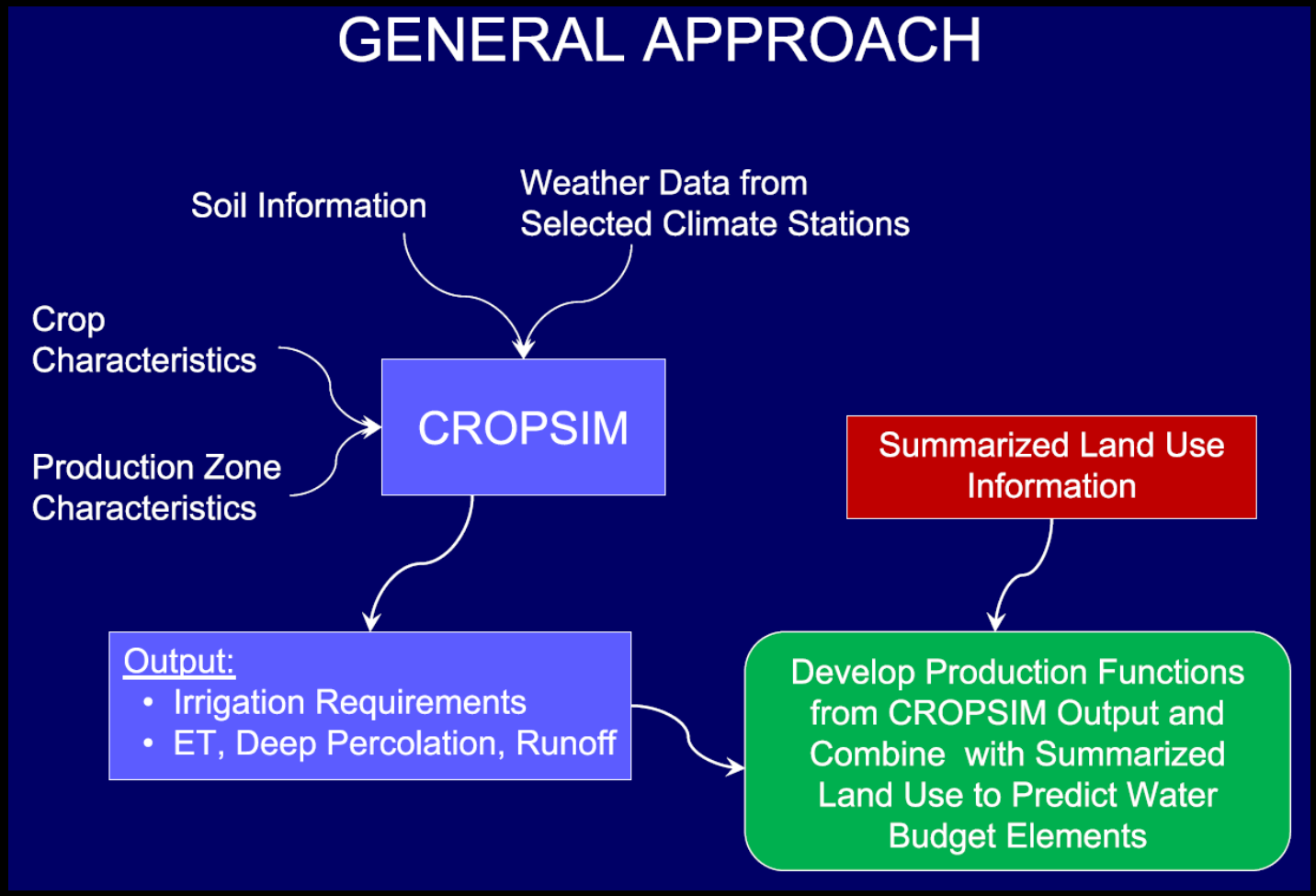


FIGURE 1 - YEARLY AVERAGE PRECIPITATION (WATER YEARS 1985-2006)

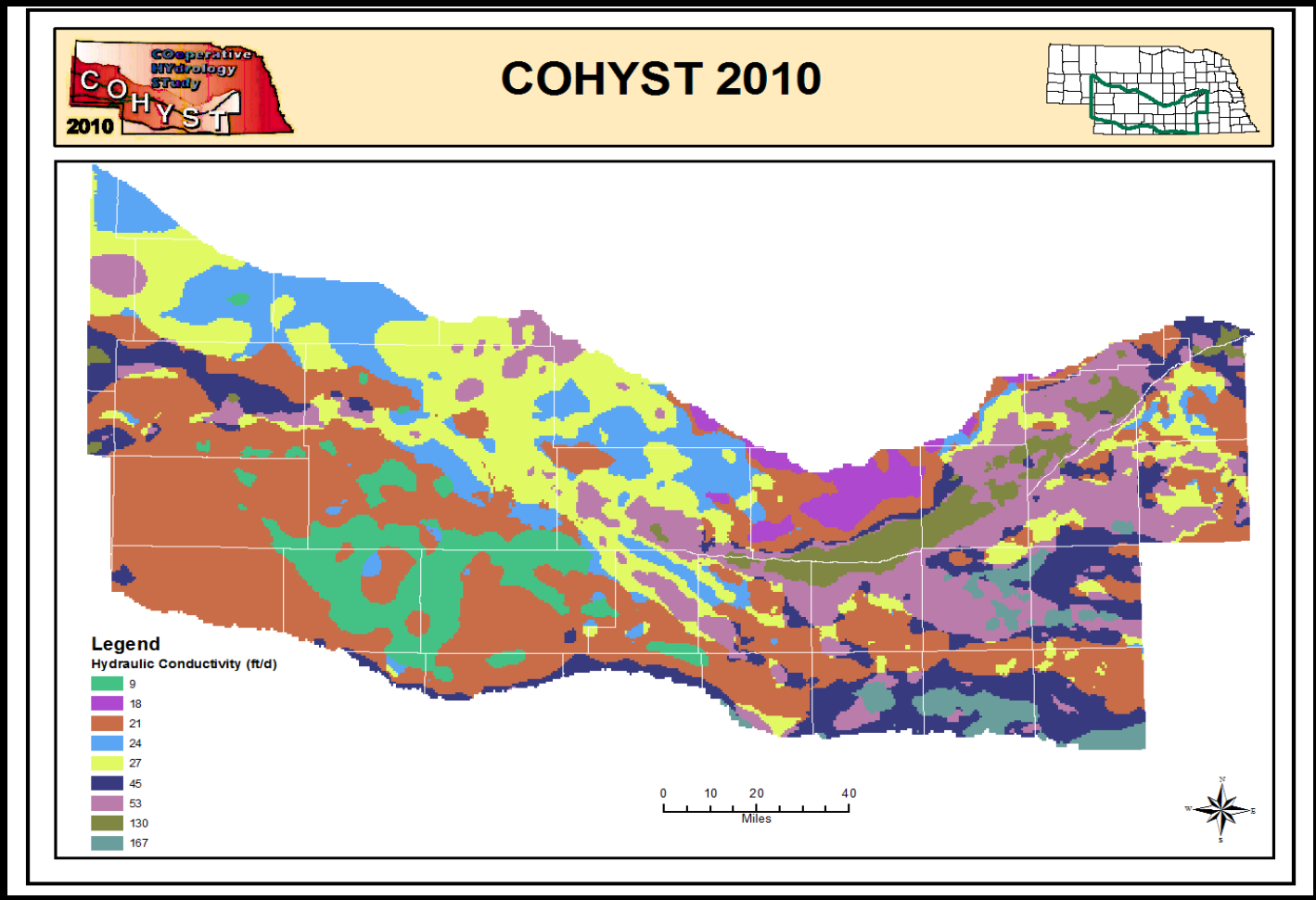
Application of IWM Modeling

Watershed Model (CROPSIM)



Application of IWM Modeling

Groundwater Model (MODFLOW)



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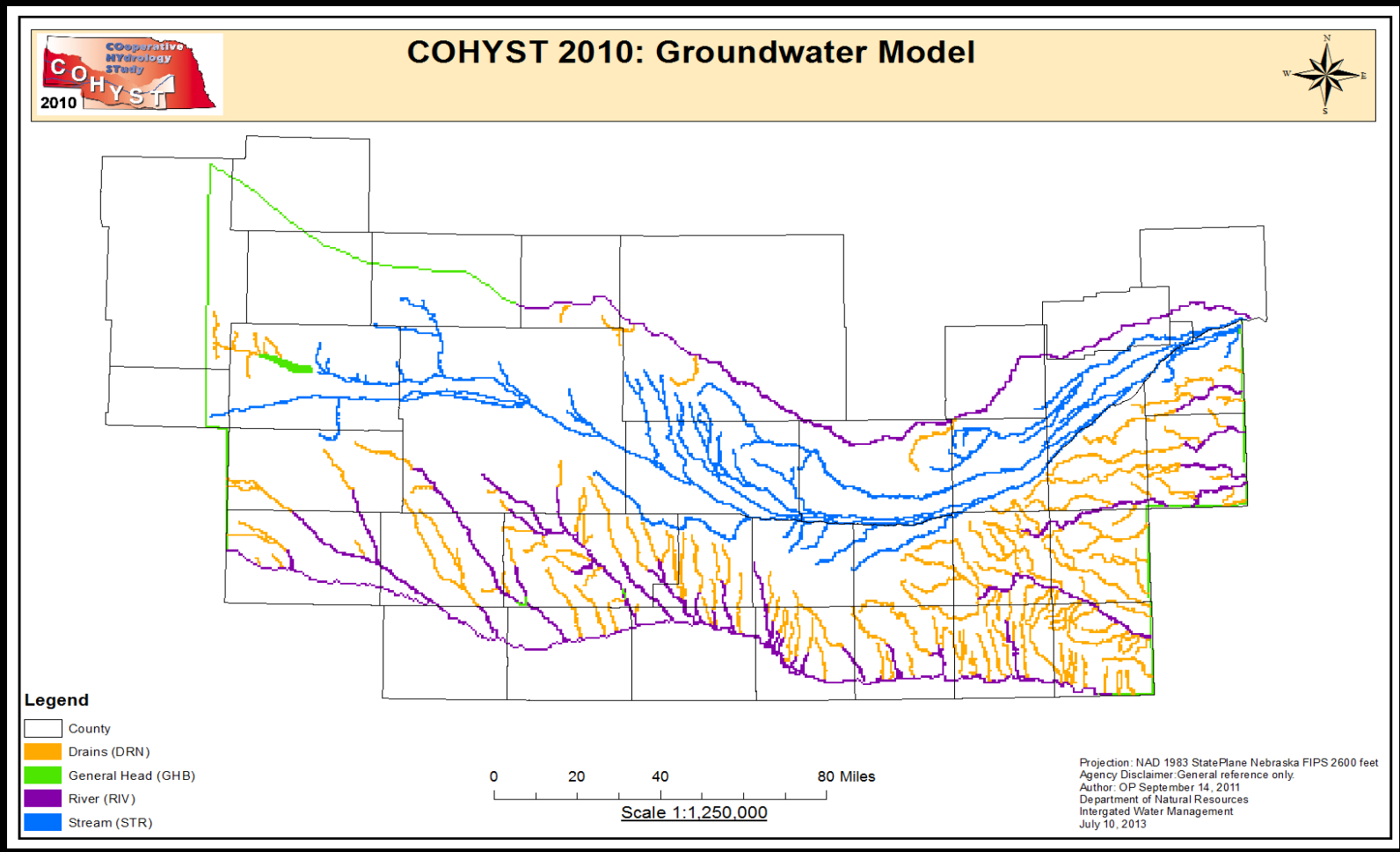

Application of IWM Modeling

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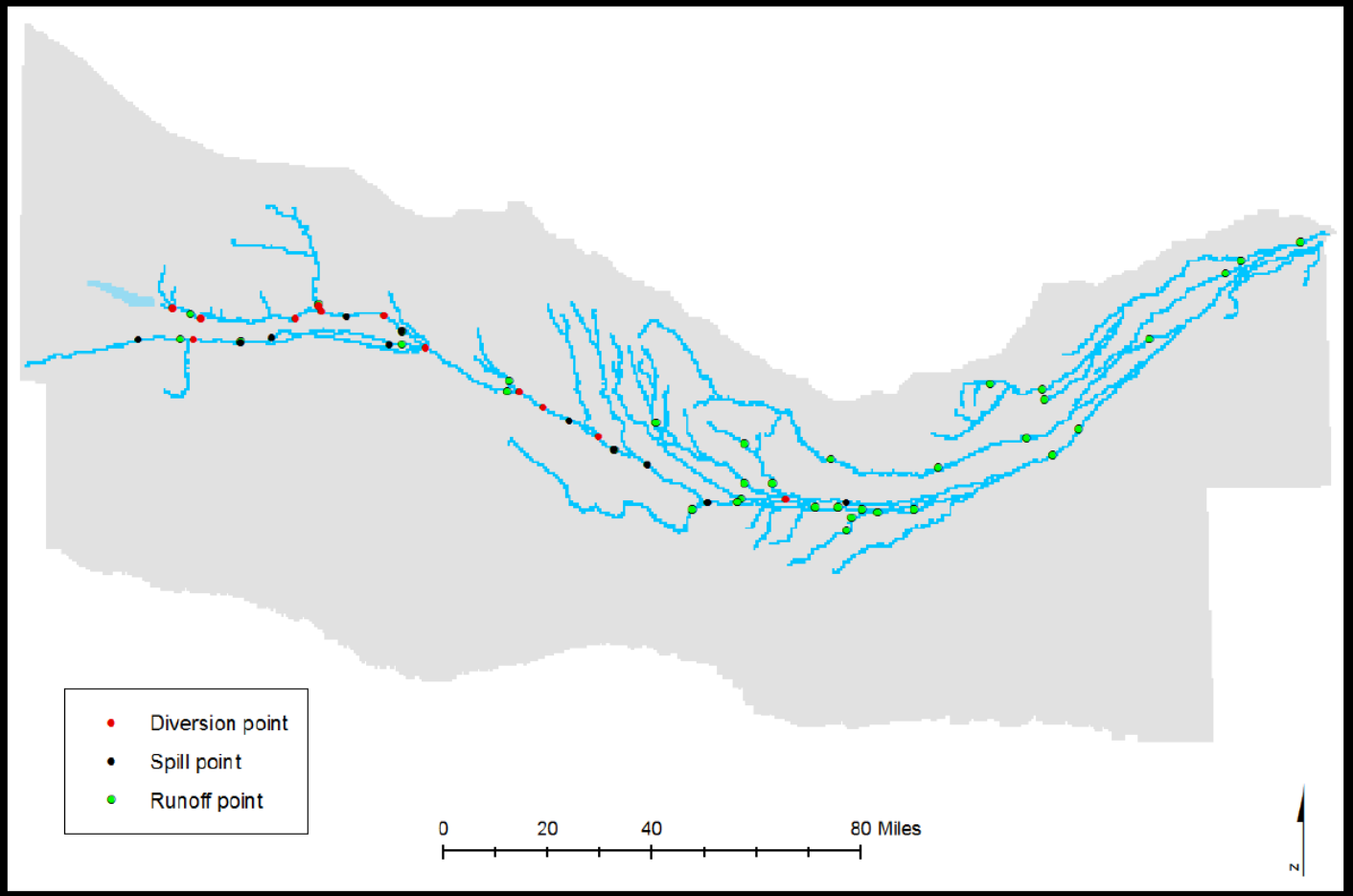
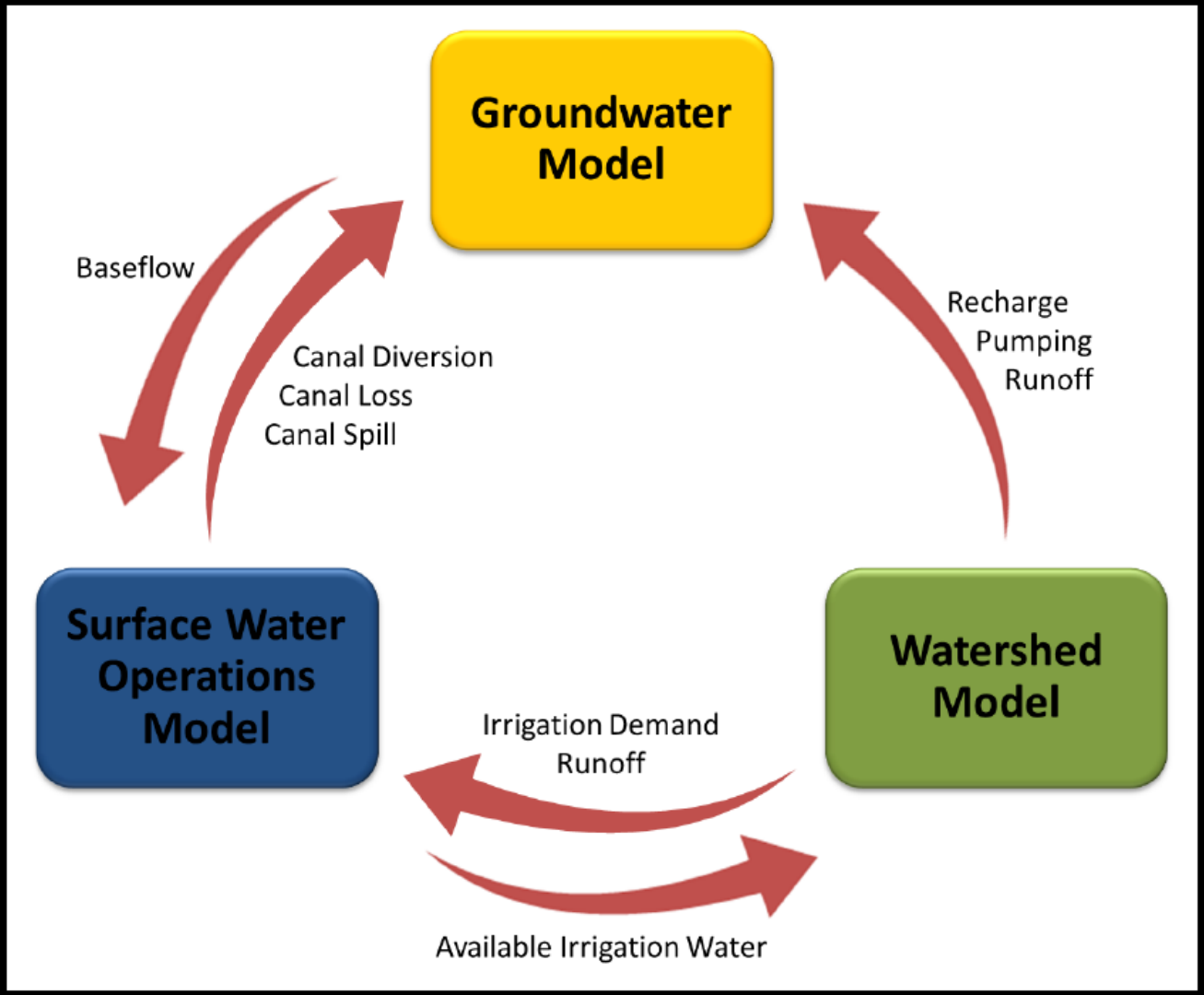
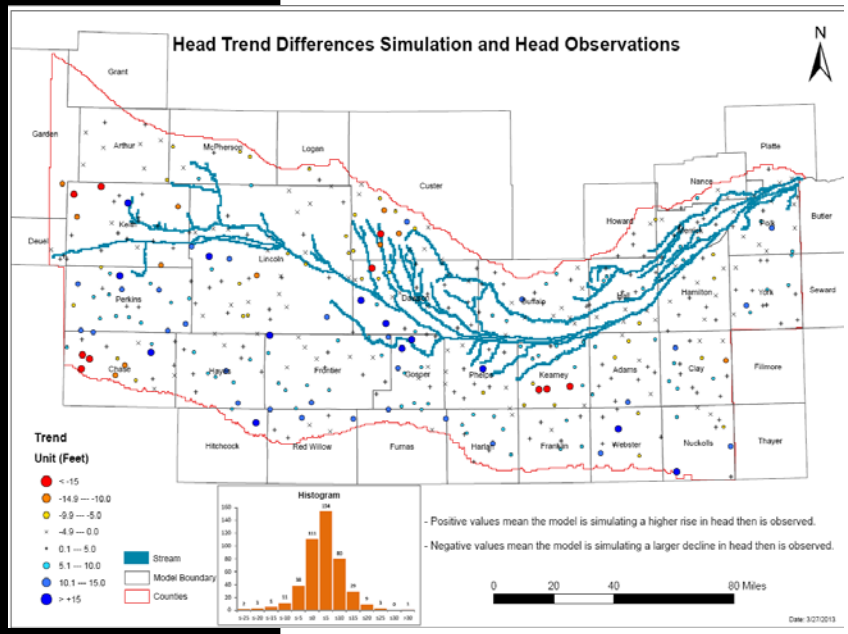


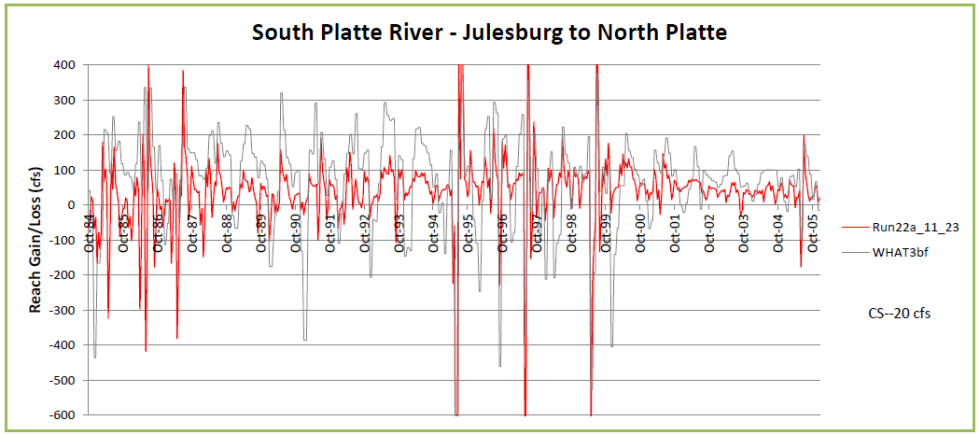
Integration of Models



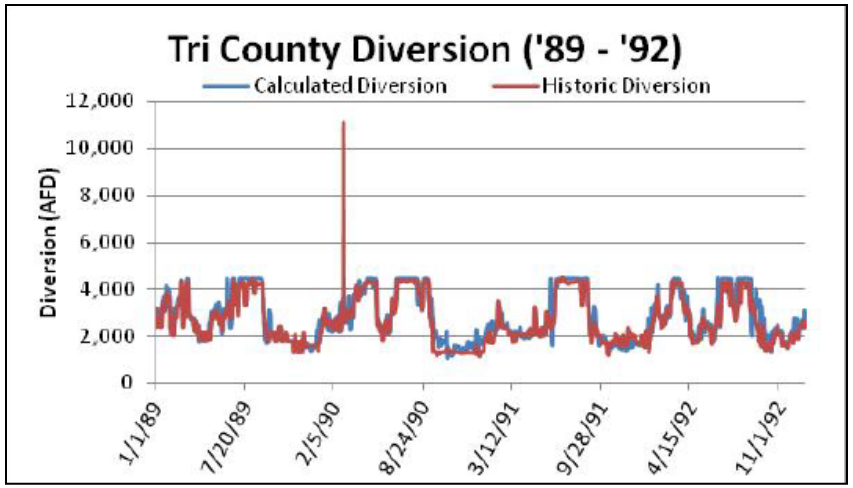
Individual Model Calibration

Groundwater Model

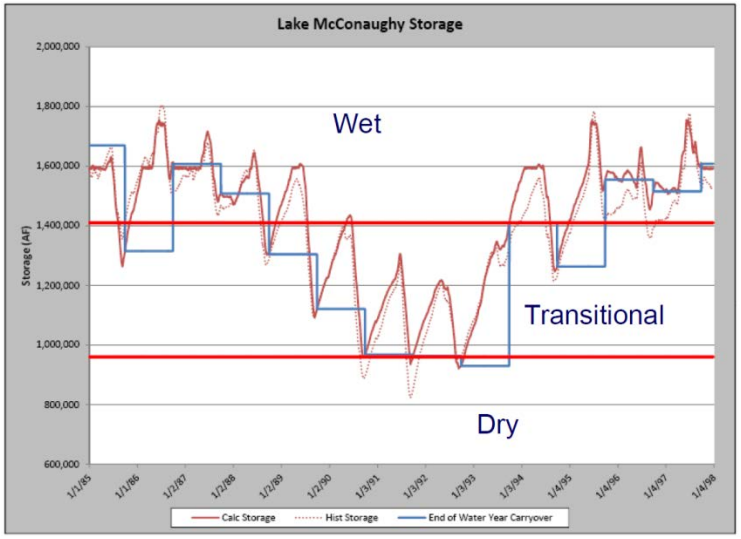




Individual Model Calibration



Surface Water Operations Model



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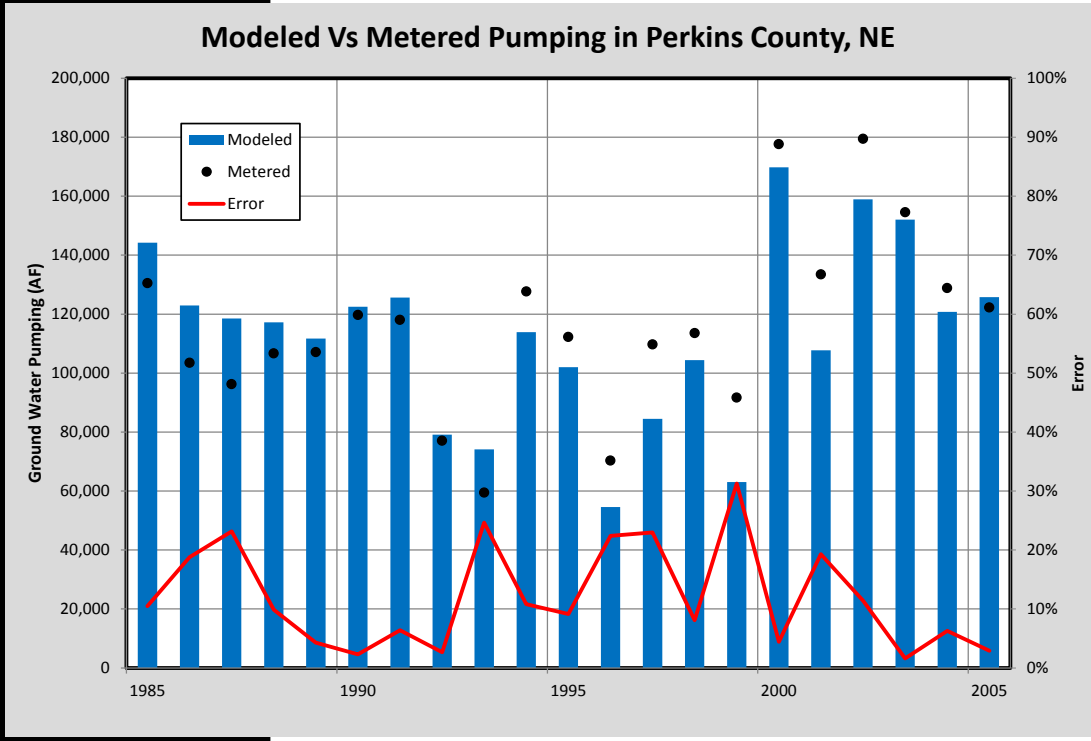
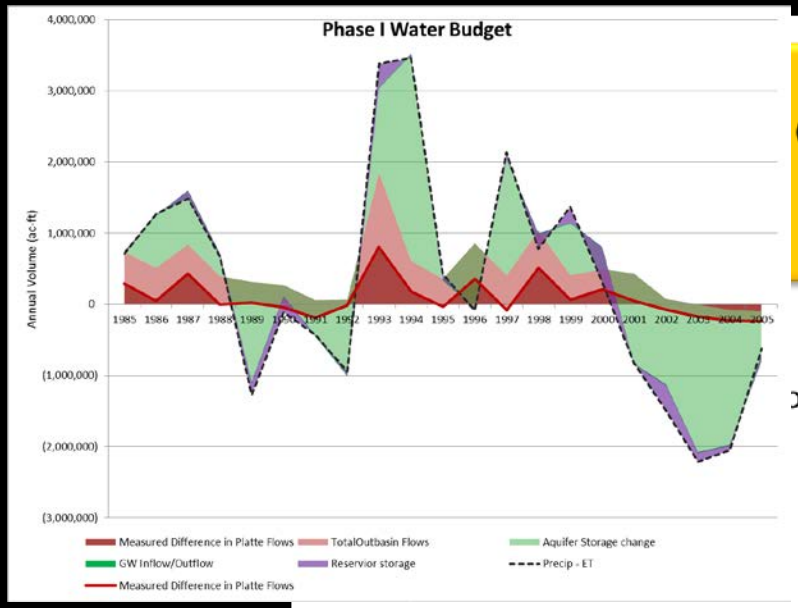
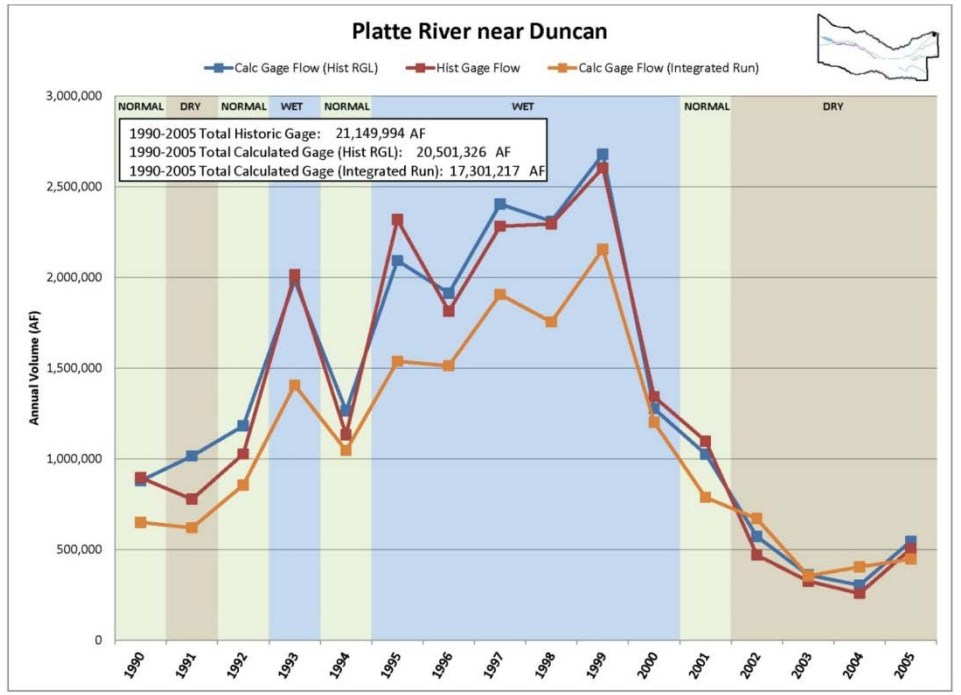


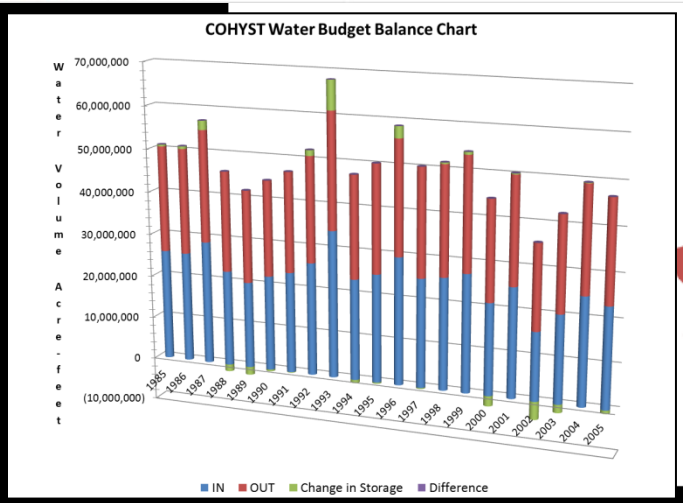
Watershed Model

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??

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