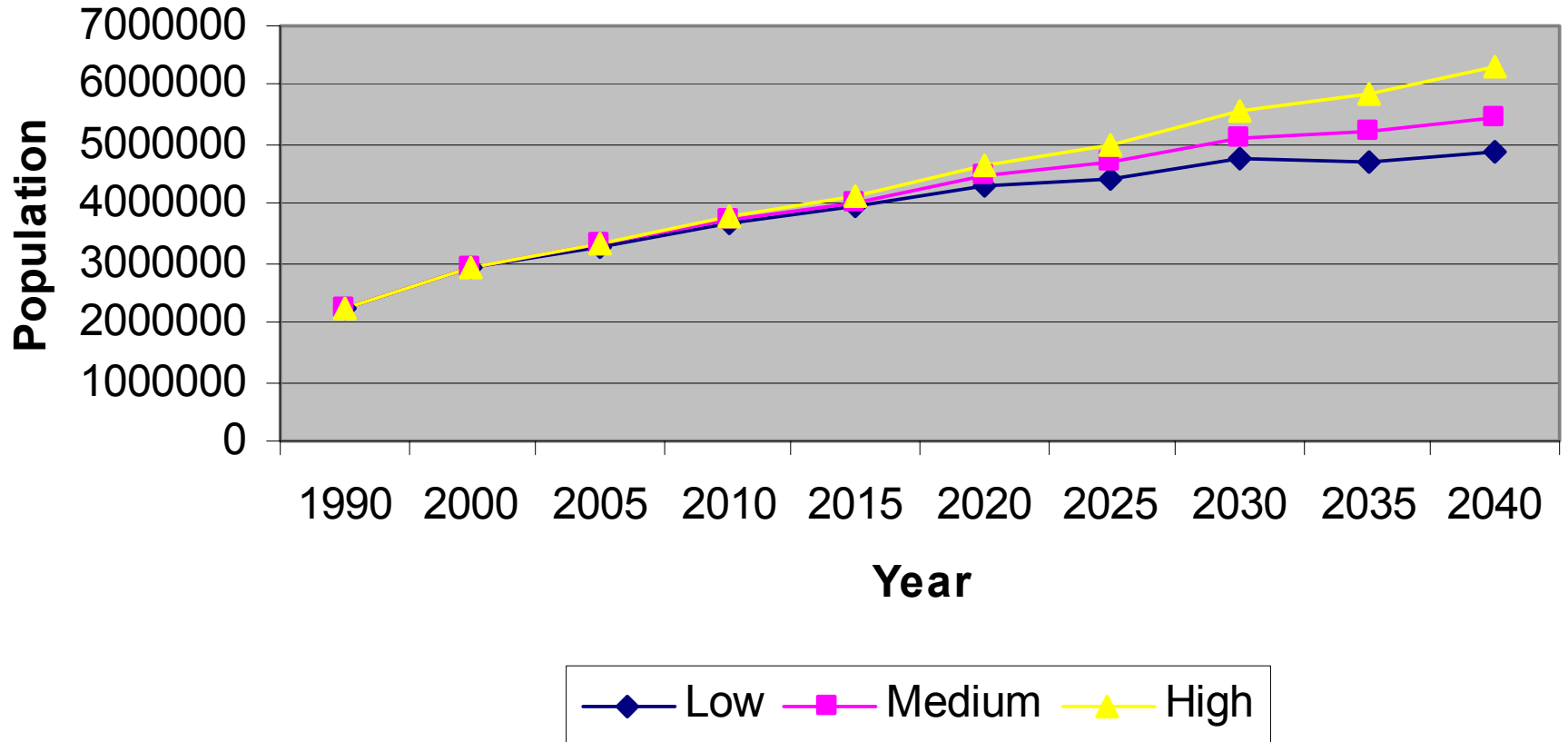


# *An Integrated Assessment of the South Platte Water Situation*

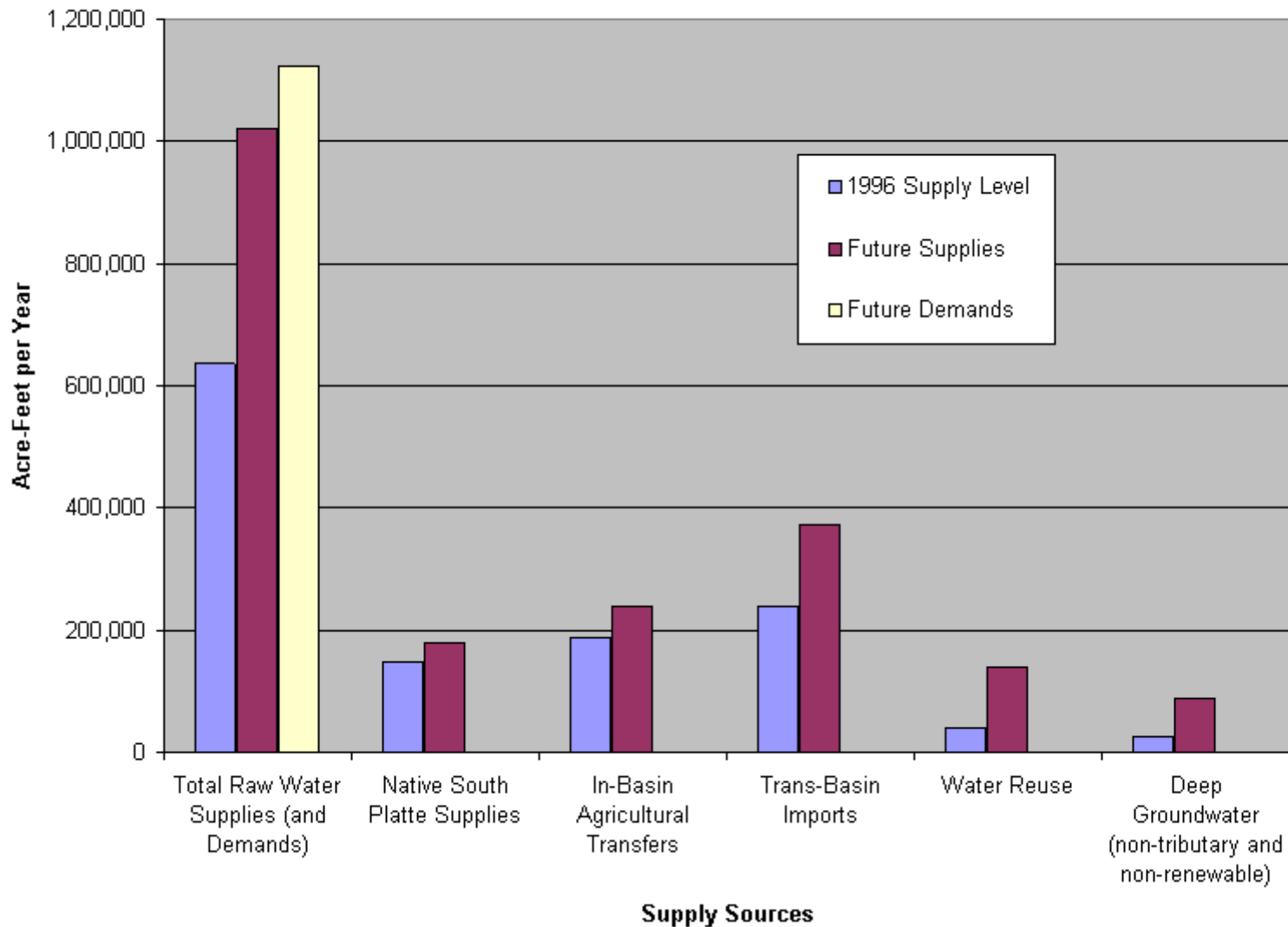
Doug Kenney, Chuck Howe, Andy Barrett, Jim Saunders, Lee Rozaklis



## South Platte -- Projected Population

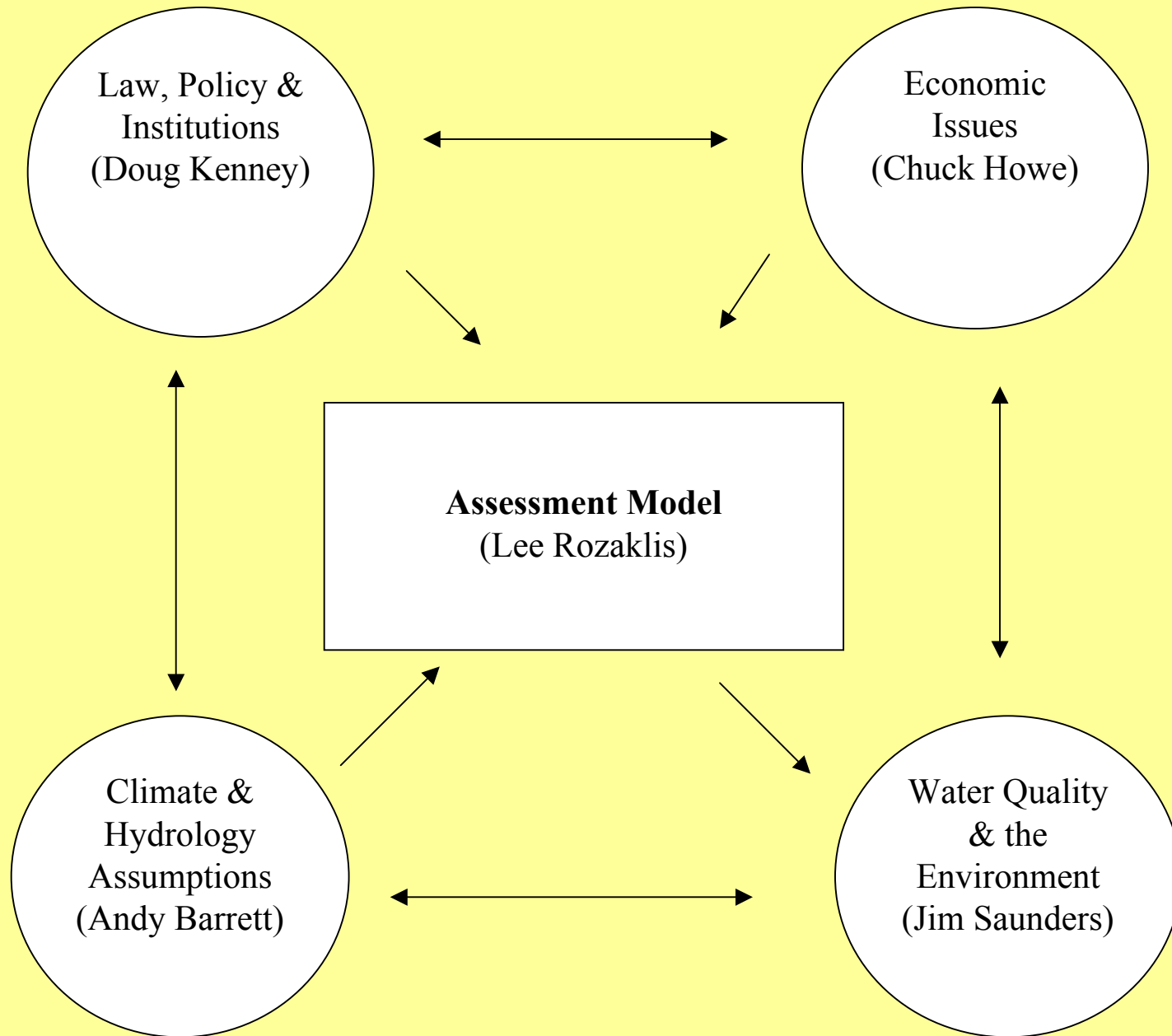


## Municipal Water Supply Sources in Colorado's South Platte Basin



# Some Key Legal and Policy Considerations

- Water Allocation, Ownership and Priorities
- Environmental Regulations
- Governance and Decision-Making



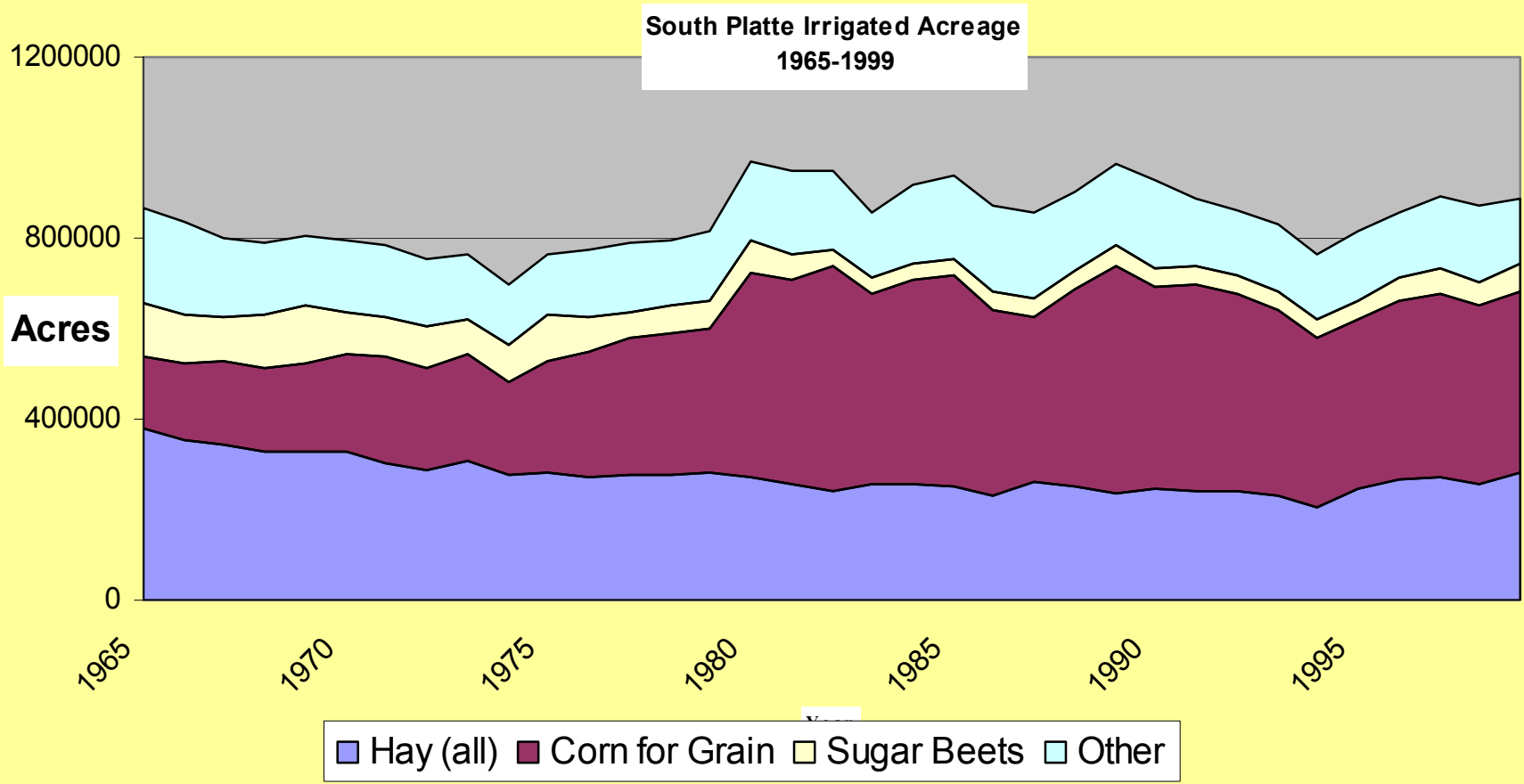
Water Demand Studies

Water Transfer Processes

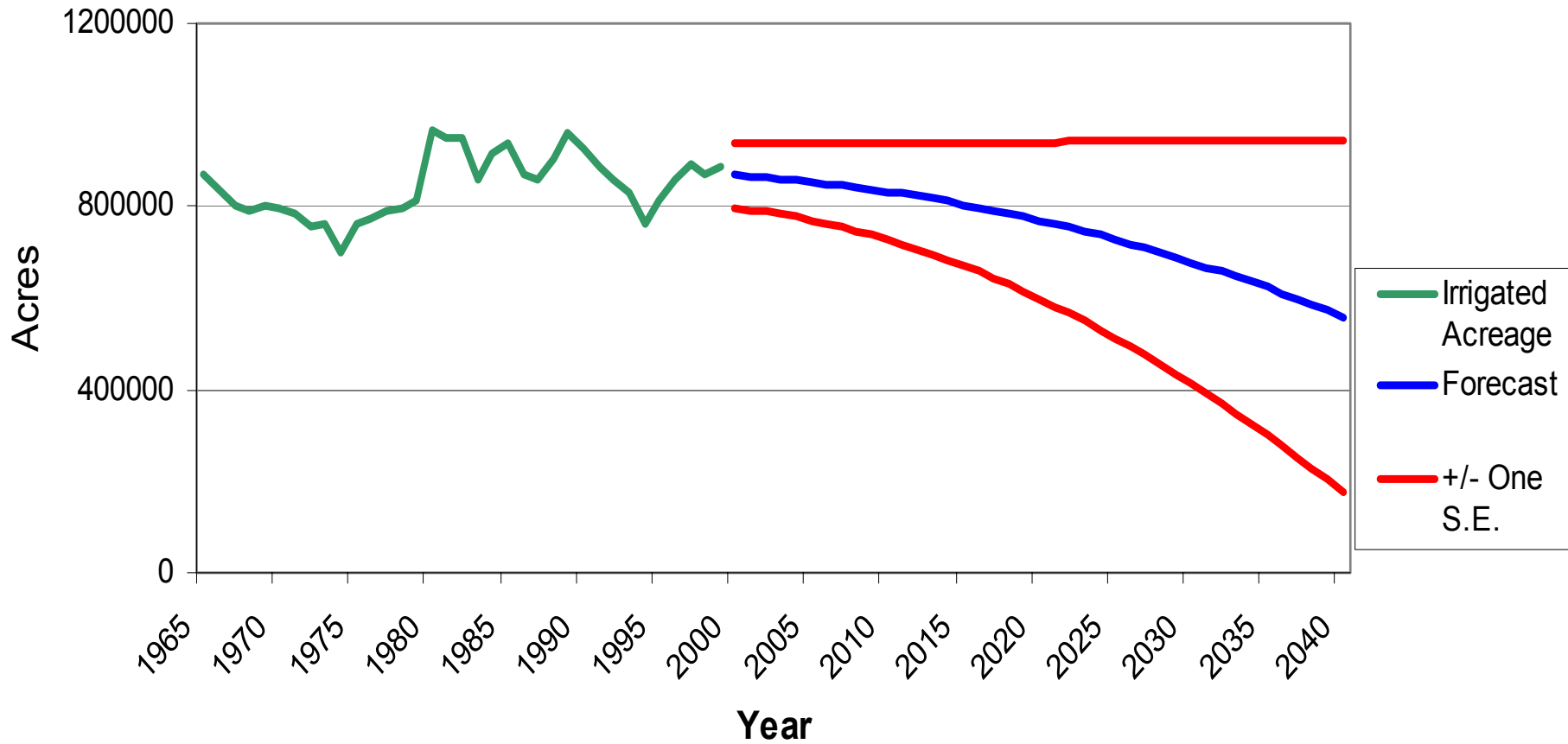
# Importance of Agriculture in Colorado and the South Platte

- 1.5% of Gross State Product
- 2.0% of Total Employment
- 92% of Total South Platte Withdrawals by Irrigation
- 89% of Total South Platte Consumptive Use by Irrigation

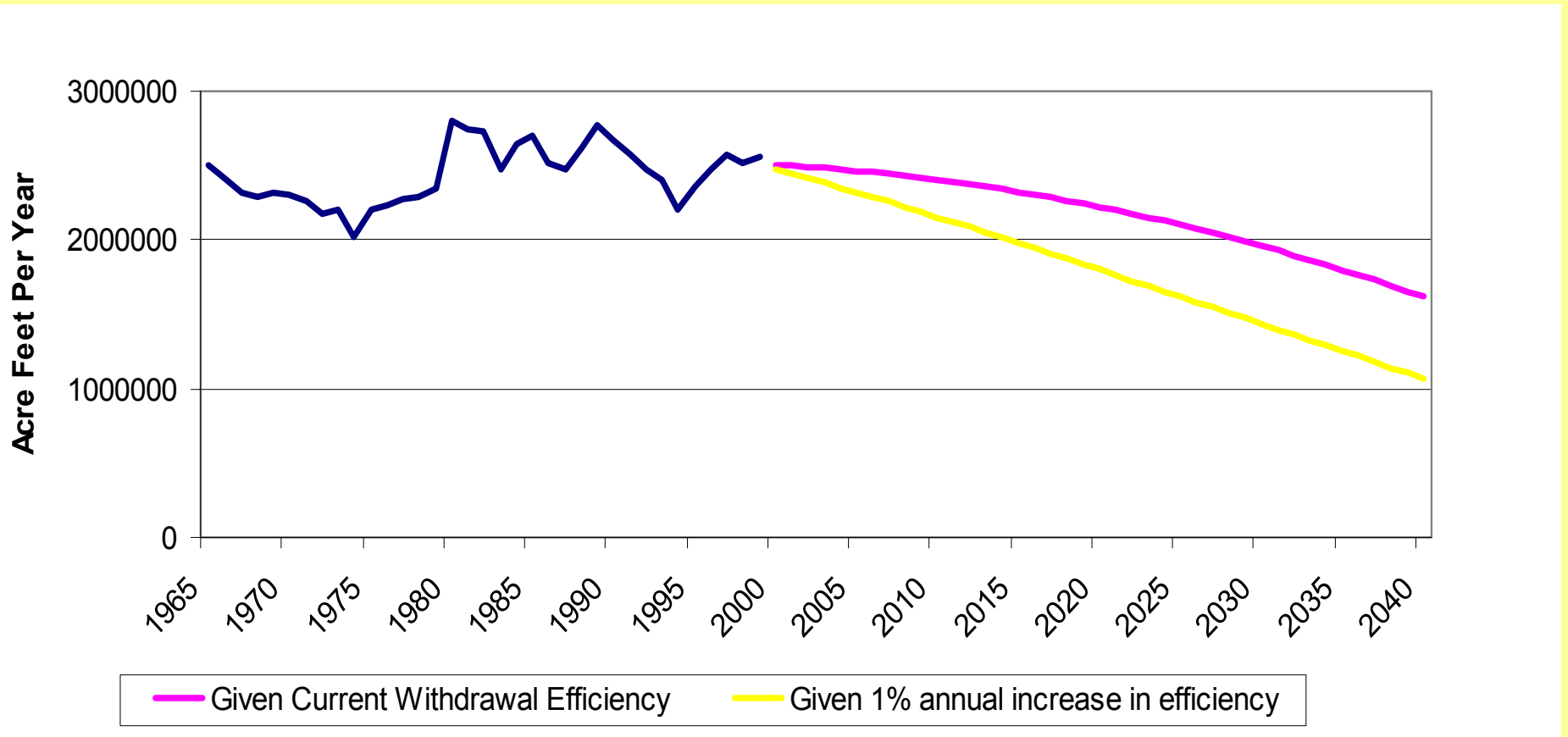
# History of Irrigated Acreage In the South Platte



# Projected Irrigated Acres

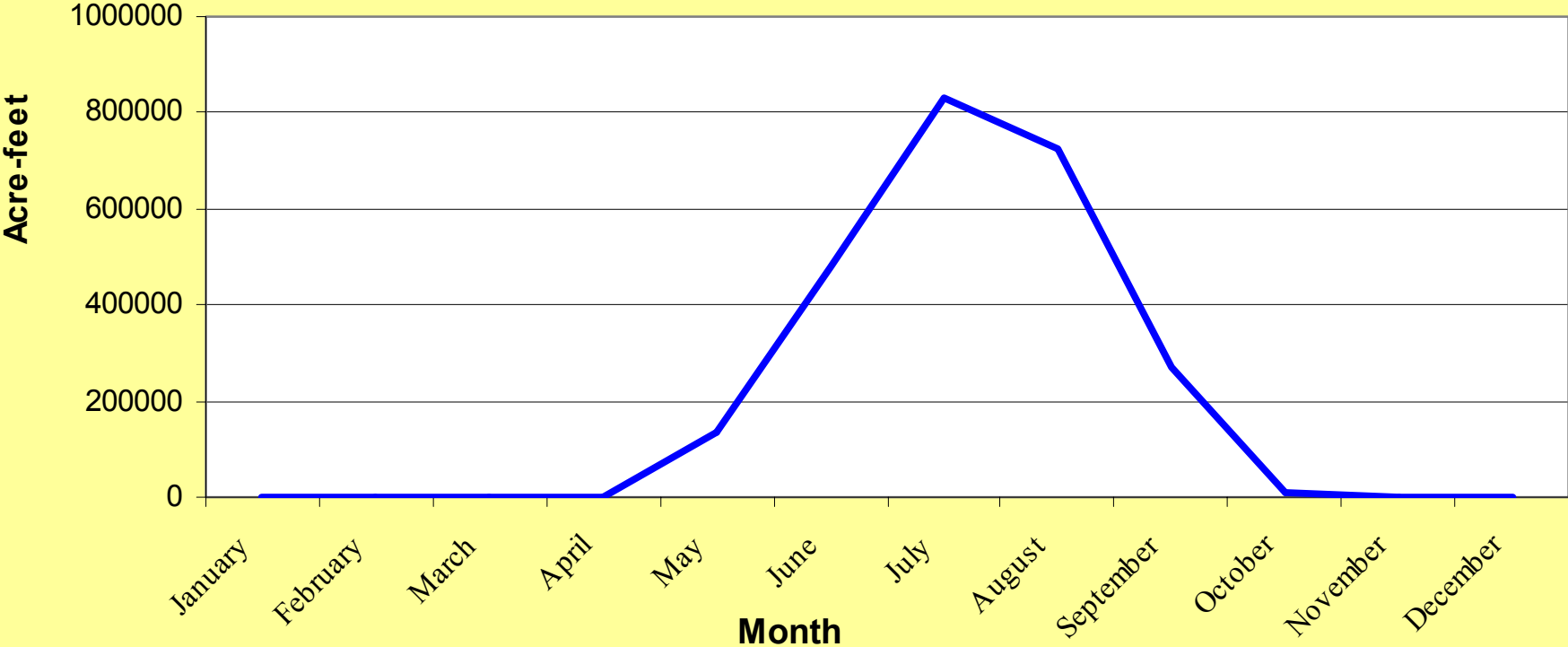


# Projected South Platte Irrigation Water Withdrawals



# Seasonality of Irrigation Withdrawals within the South Platte

**South Platte**  
**Monthly Agricultural Demand for Water**



# Types of Ag and M&I Water Transfer Process

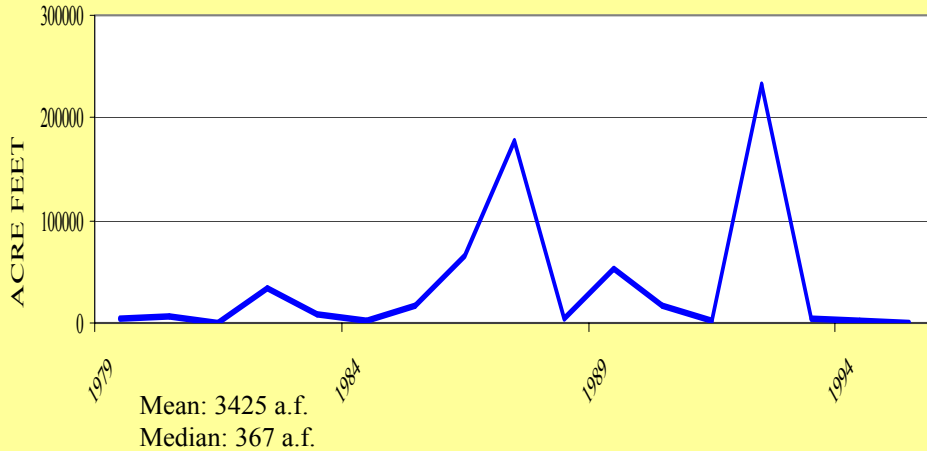
- Natural annexation processes
- Non-contiguous, same basin transfers
- Out-of-basin transfers

# Nature of Water Transfers in the South Platte Basin

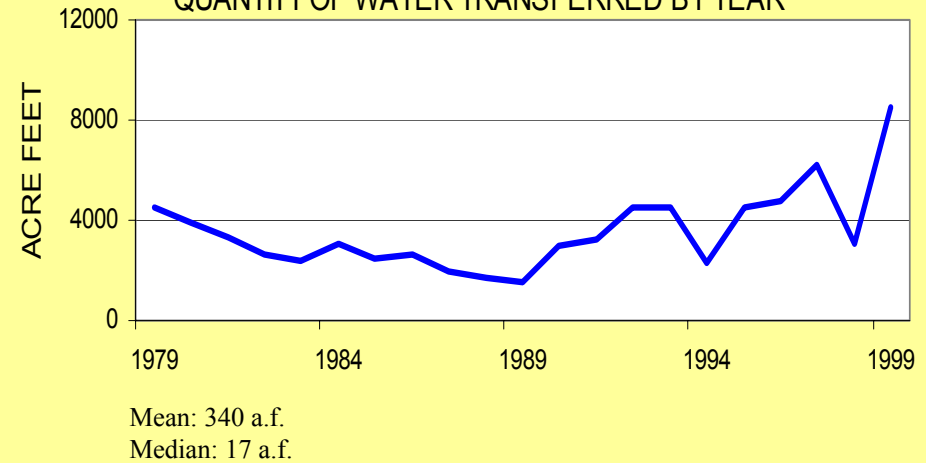
## *Division 1*

## *NCWCD*

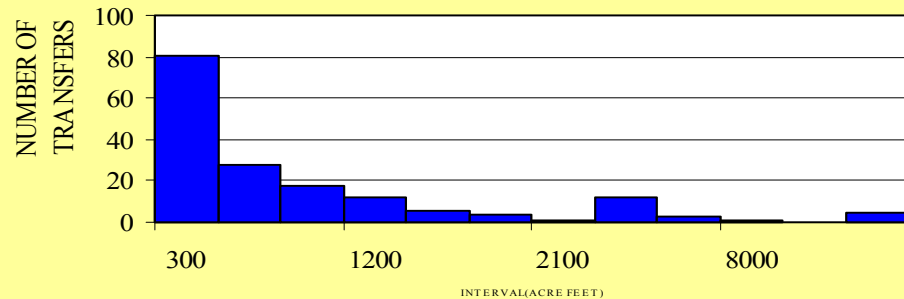
SOUTH PLATTE  
QUANTITY OF WATER TRANSFERRED BY YEAR



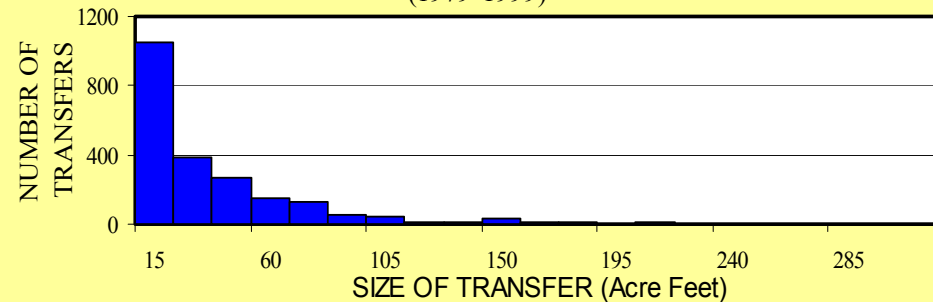
NCWCD  
QUANTITY OF WATER TRANSFERRED BY YEAR



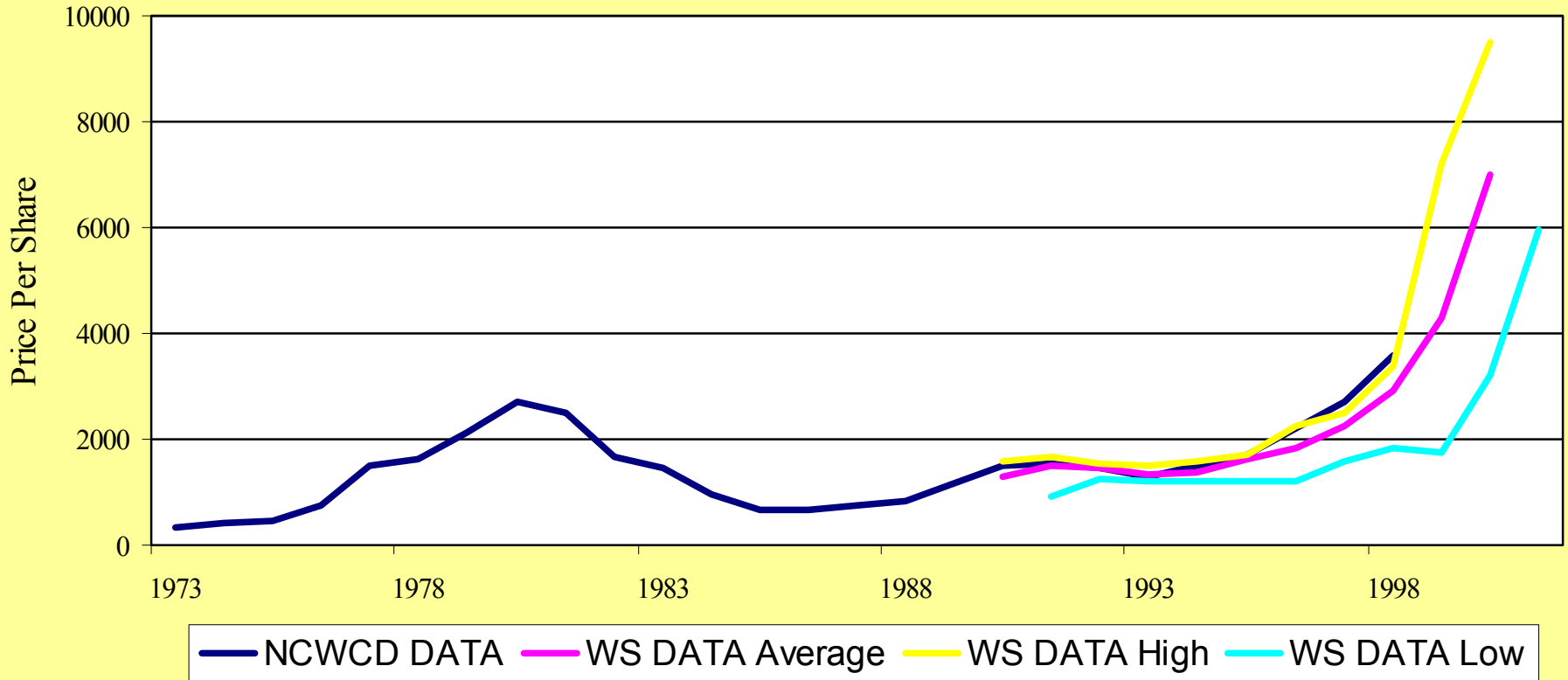
SOUTH PLATTE DISTRIBUTION OF  
TRANSFERS BY SIZE (1979-1995)



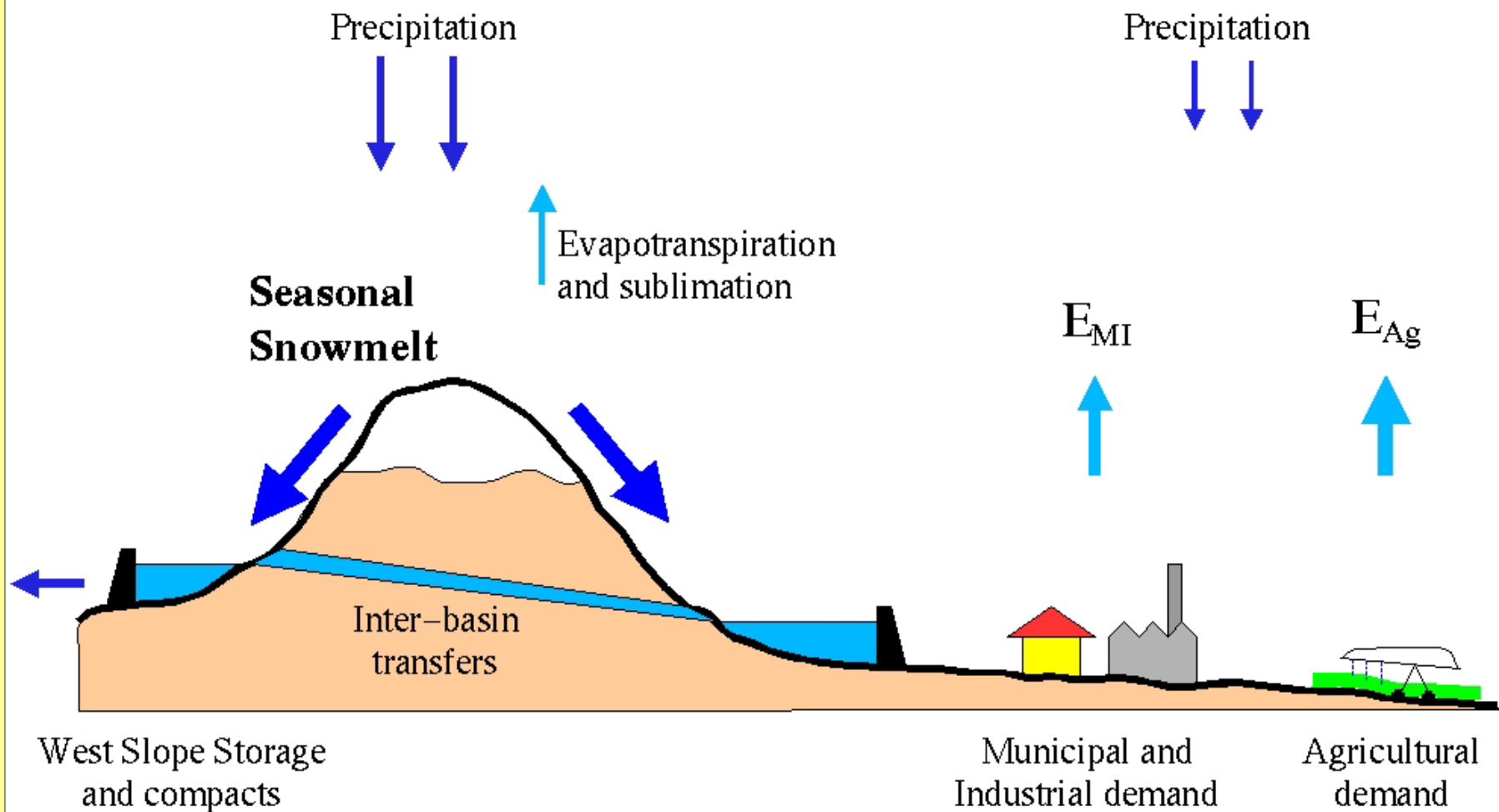
NCWCD FREQUENCY DISTRIBUTION  
(1979-1999)



# CBT PRICE DATA

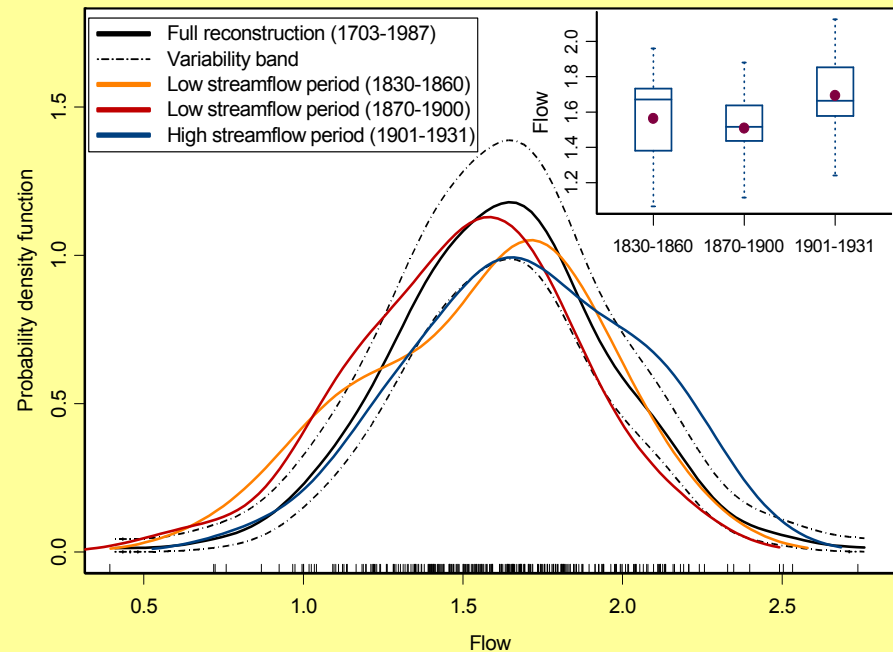


# Climate Driven Water Supply and Demand in the South Platte Drainage Basin



# Climate Scenarios

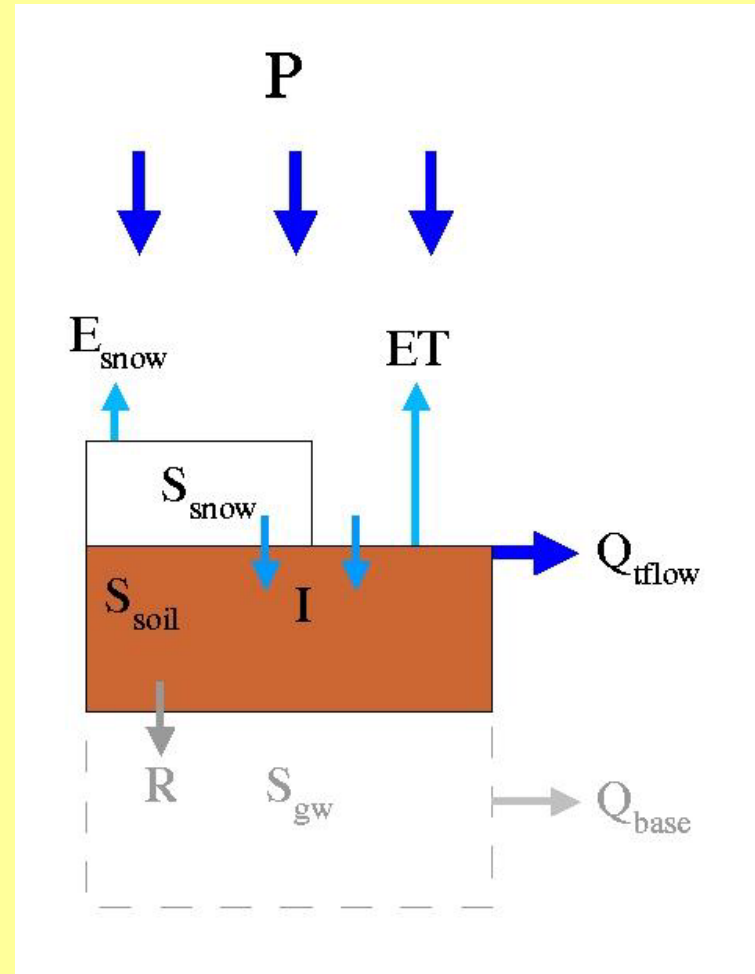
- Need to capture changes through time in both **variability** of extremes and **mean** of runoff.
- Can be achieved using:
  - Downscaled GCM output;
  - Historical data from Tree Ring Analyses.
- As an initial step we use a simple perturbation of historical time series by  $\Delta T (\pm 4 \text{ }^\circ\text{C})$  and  $P(\pm 10\%)$ .



(Jain *et al.*, in preparation)

# A Simple Water Balance Model

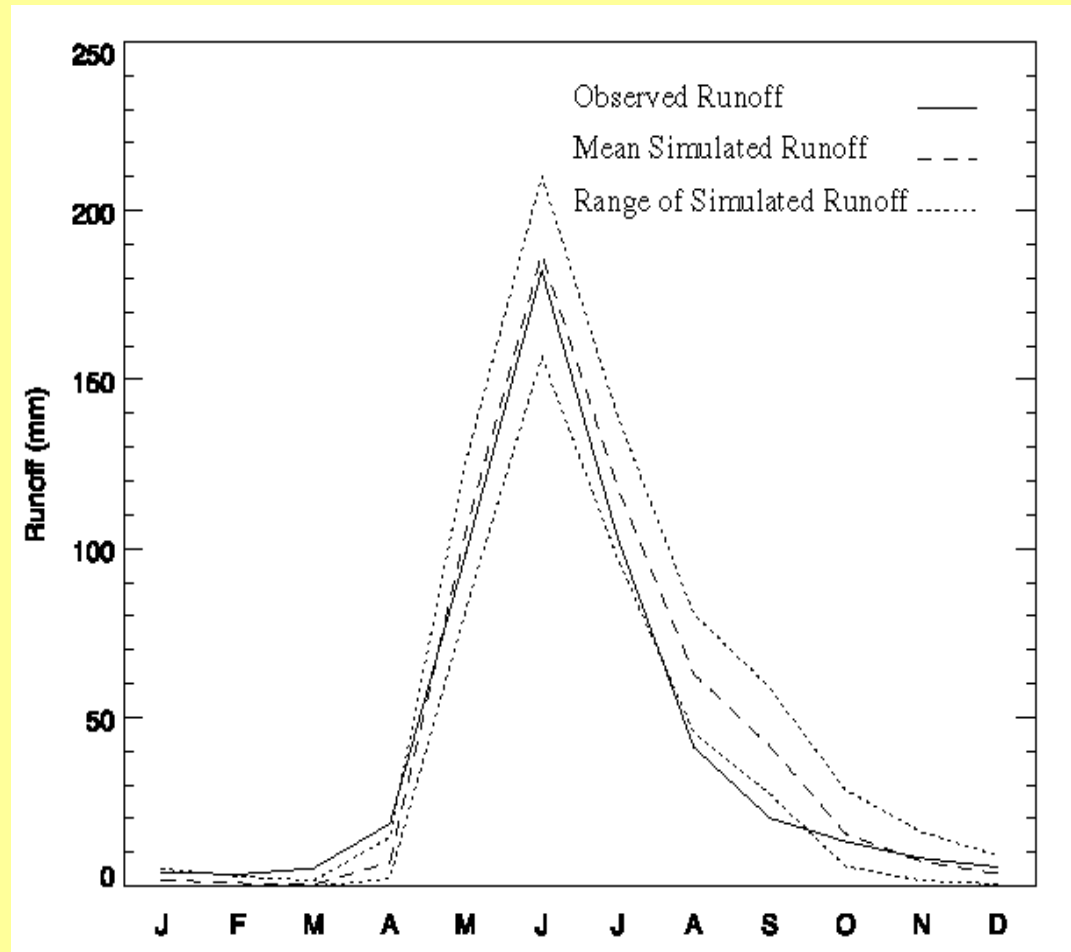
- Characterises climatic supply and demand.
- Includes snow accumulation and melt, soil moisture storage.
- Driven by:
  - Mean temperature;
  - Total precipitation.



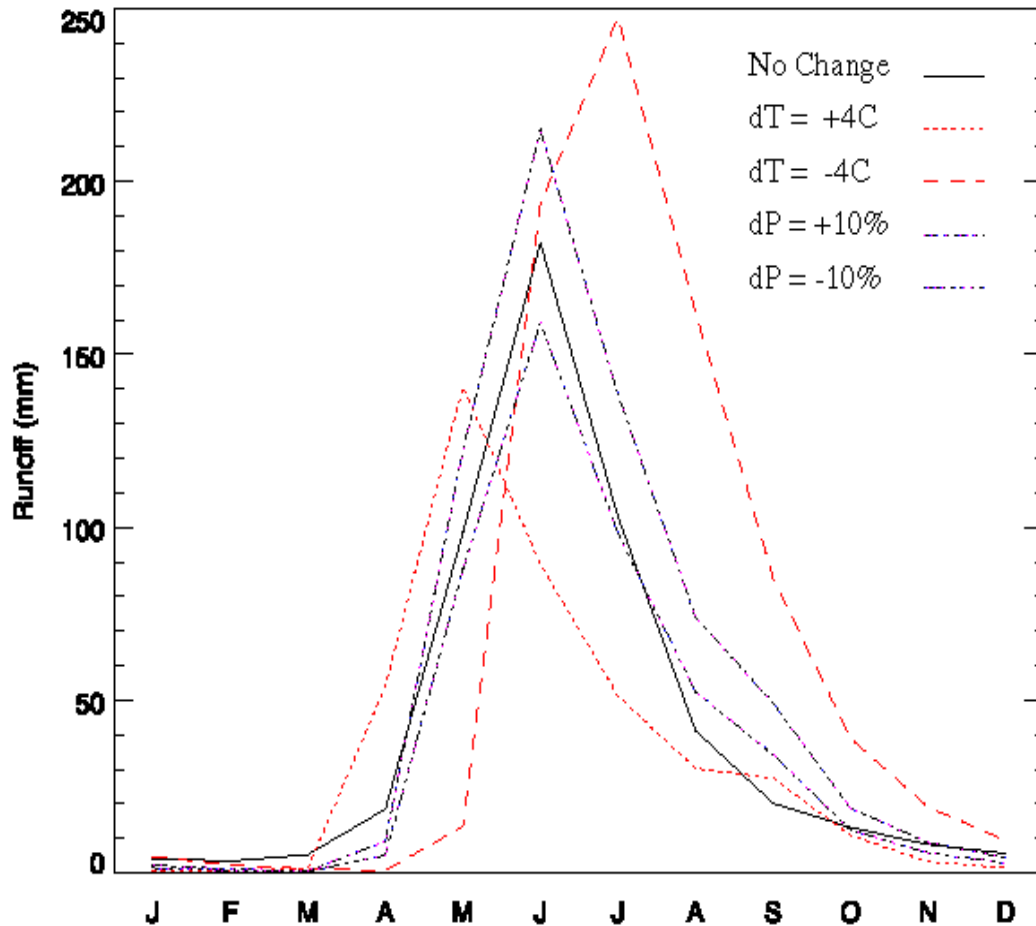
# Model Calibration and Validation

- No one 'best' model but many acceptable models.
- Monte Carlo sampling of parameters to generate multiple models.
- Produces a range of simulated runoff.
- Runoff traces are weighted by an index of acceptability

Mean flows for Middle Boulder Creek



# Runoff Scenarios

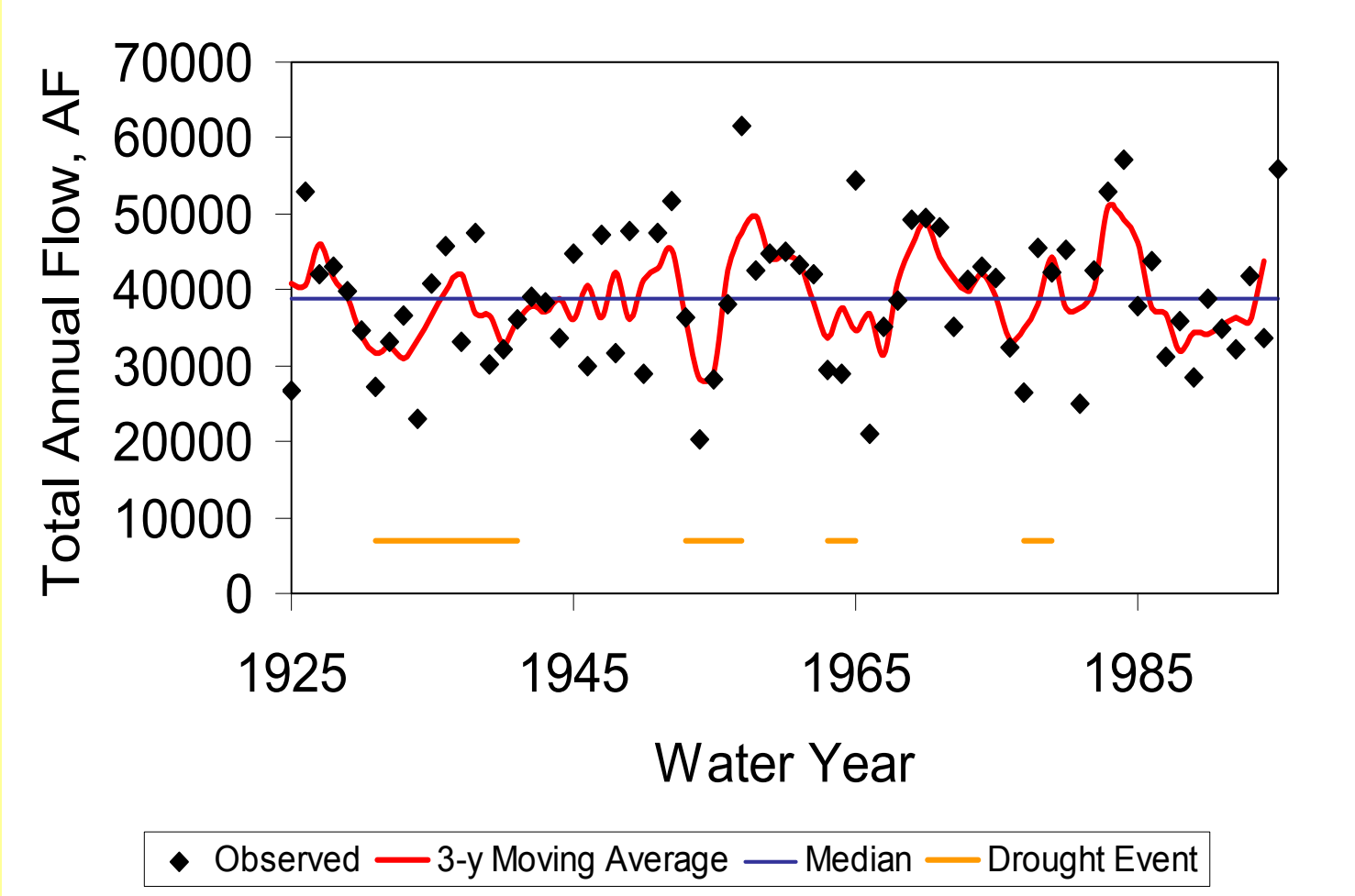


- Runoff scenarios mimic those of other workers
- Increased T results in earlier and lower peak flows
- Decreased T delays peak flows and increases total runoff
- Changes in P only change peak runoff volume

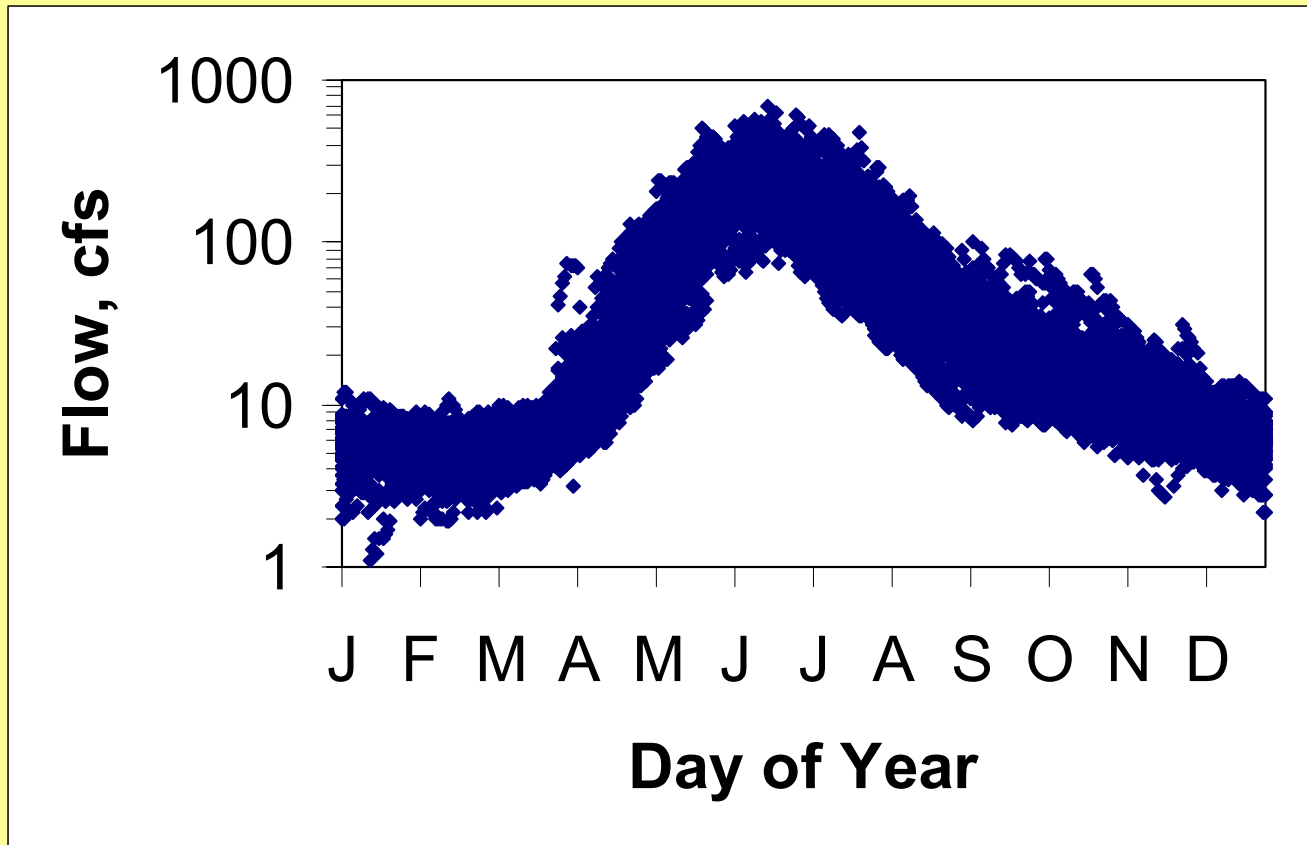
# Water Quality and the Environment

- The dynamic overlay of water management practices and climate variability increases the vulnerability of aquatic communities.
- The regulatory framework designed to protect aquatic communities:
  - has no provision for incorporating climate variation
  - is focused on low flow conditions

# Interannual Variation of Flow in Middle Boulder Creek



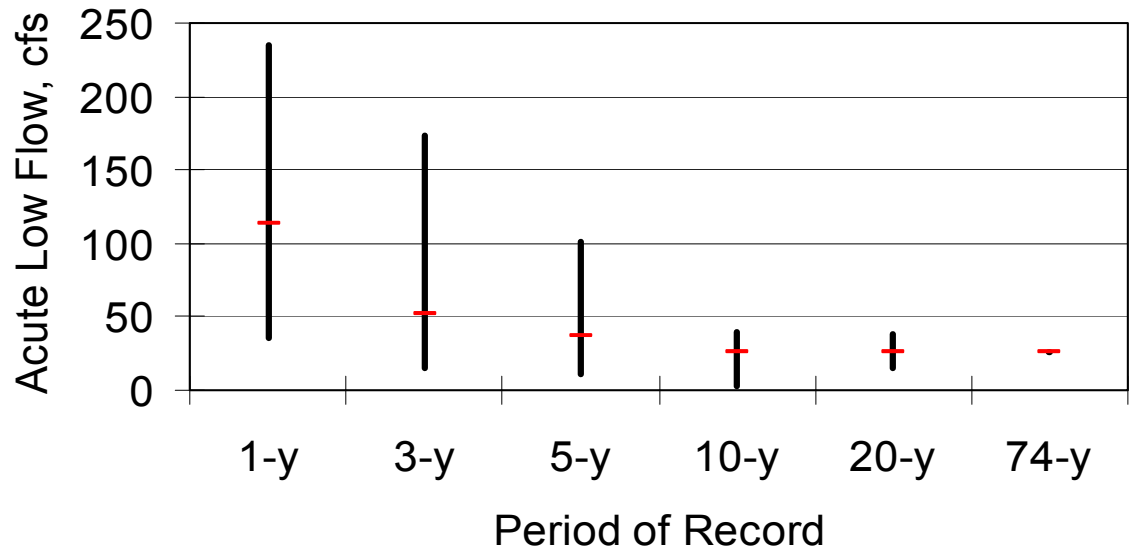
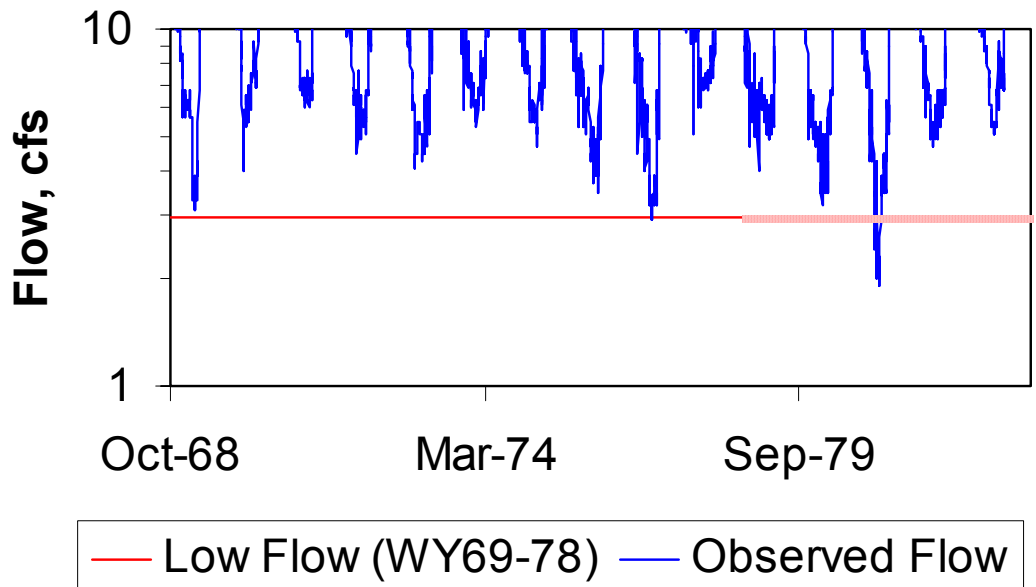
# Seasonal Variation of Flow in Middle Boulder Creek



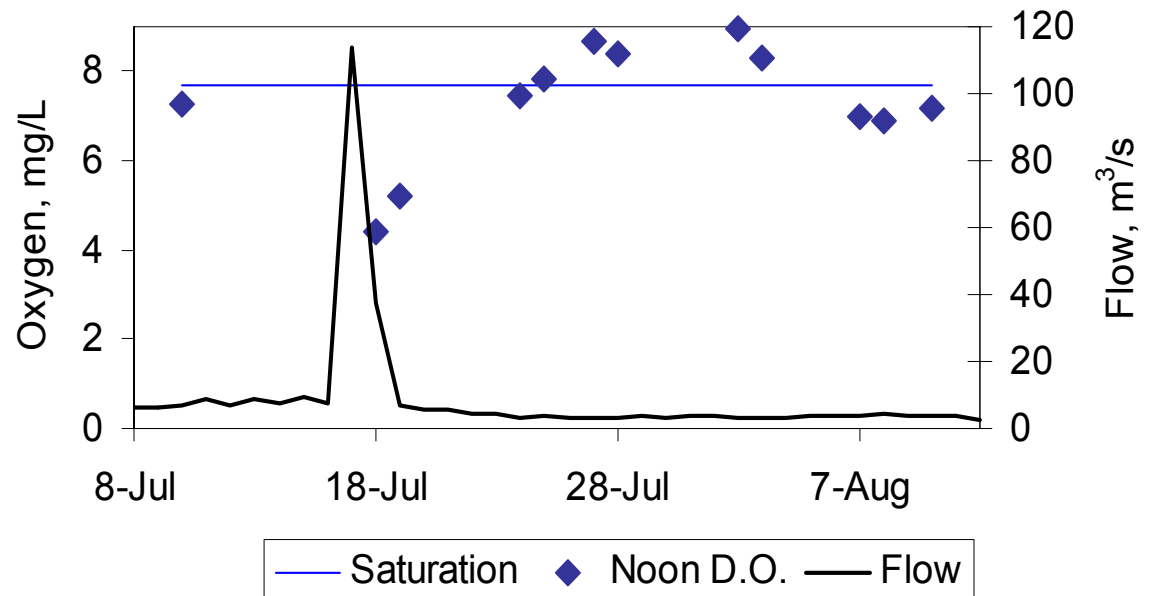
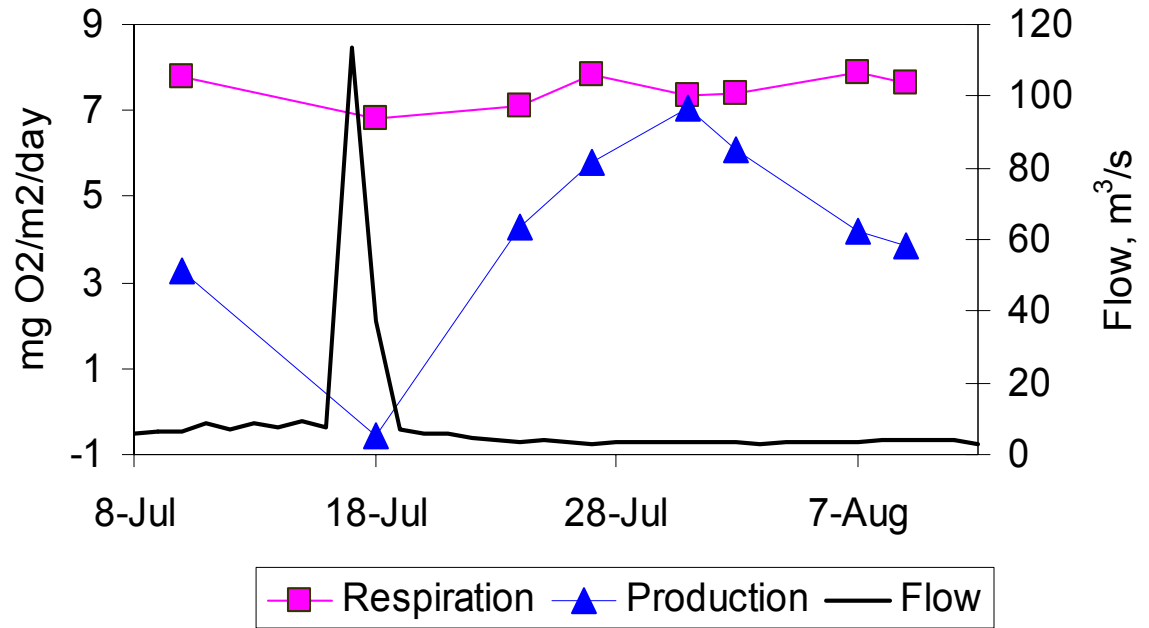




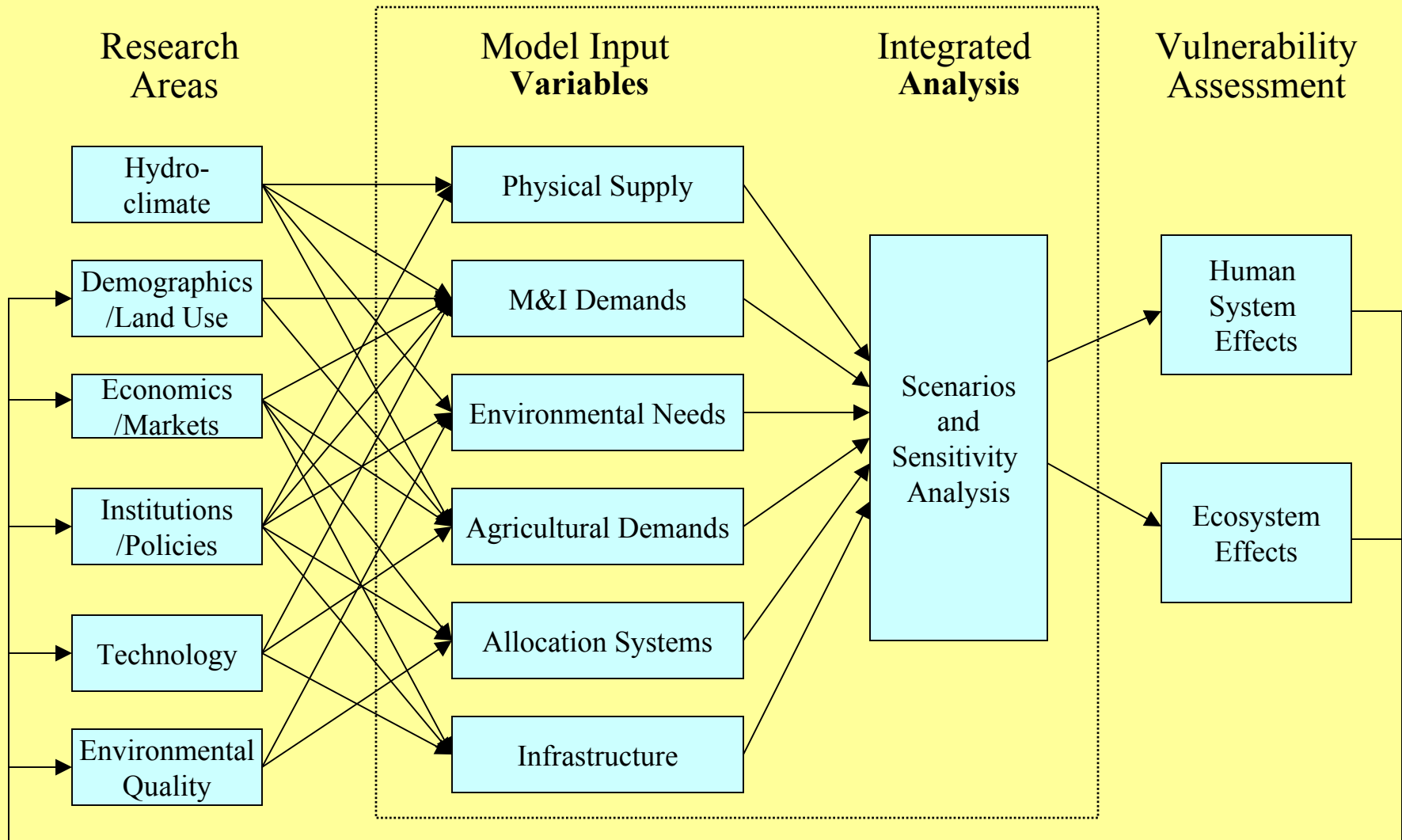
# Effect of Climate Variation on Calculation of Regulatory Low Flows



# Effect of Flushing Flow on Biological Processes and Dissolved Oxygen in the South Platte



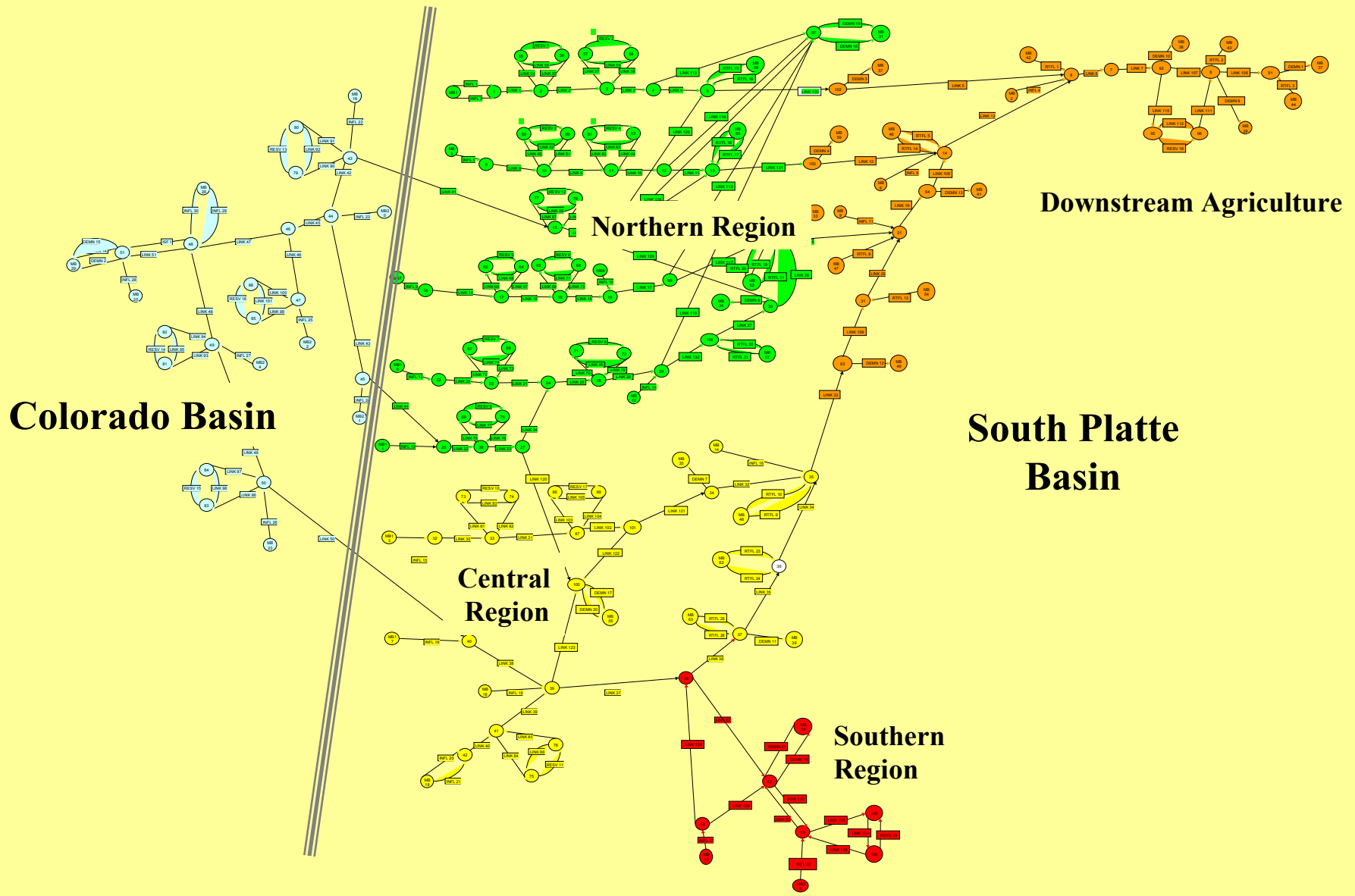
# Role of Regional Assessment Model



# Model Components

- Surface inflows
- Stream topology
- Water rights
- Infrastructure
- Water demands
- Return flows
- Aquifer interactions

# Spatial Aspects of Regional Assessment Model



# Assessment Scenarios

- Population growth
- Climate variability
- Land use trends
- Environmental requirements
- Policies