

Planning Workshop

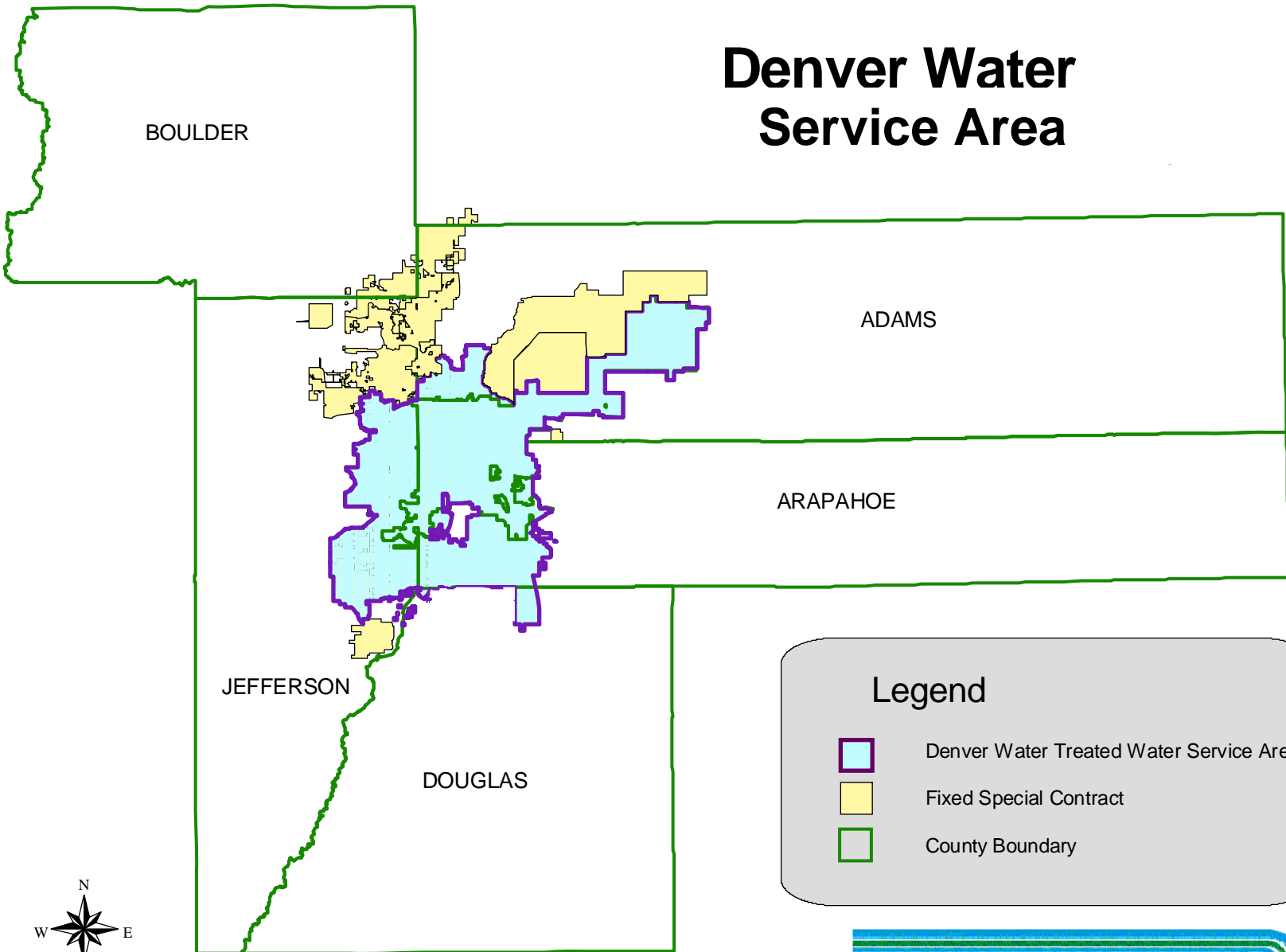
May 9, 2006

**Denver Water's Use of Tree Ring-based
Stream Flow Reconstructions in Water
Resources Management**




Steve Schmitzer



Denver Water Service Area

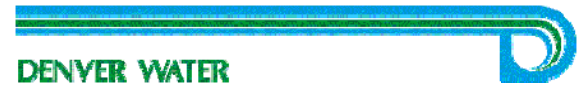


Legend

-  Denver Water Treated Water Service Area
-  Fixed Special Contract
-  County Boundary

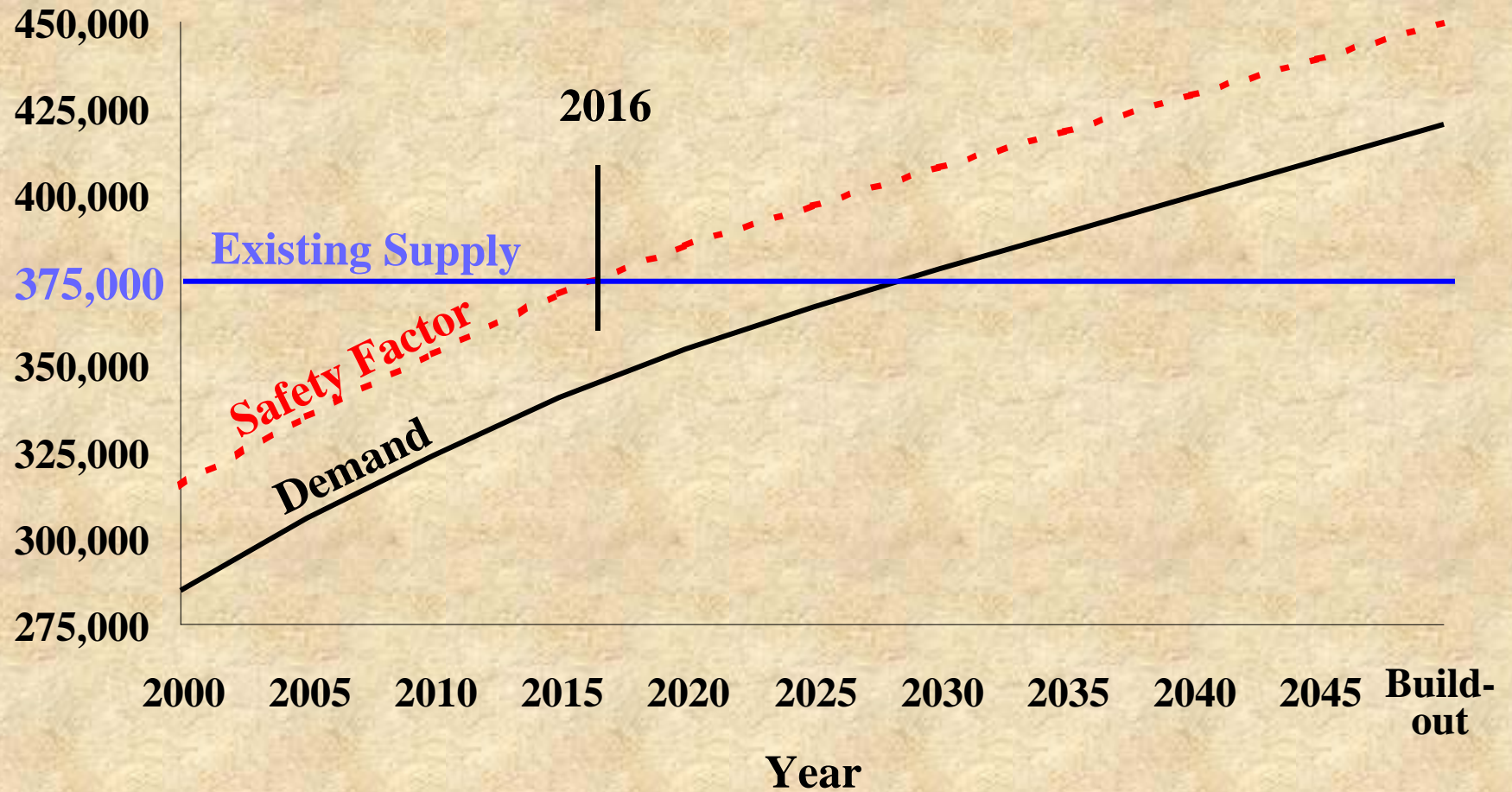
September 2000

10 0 10 Miles



Demand and Supply

Acre-Feet



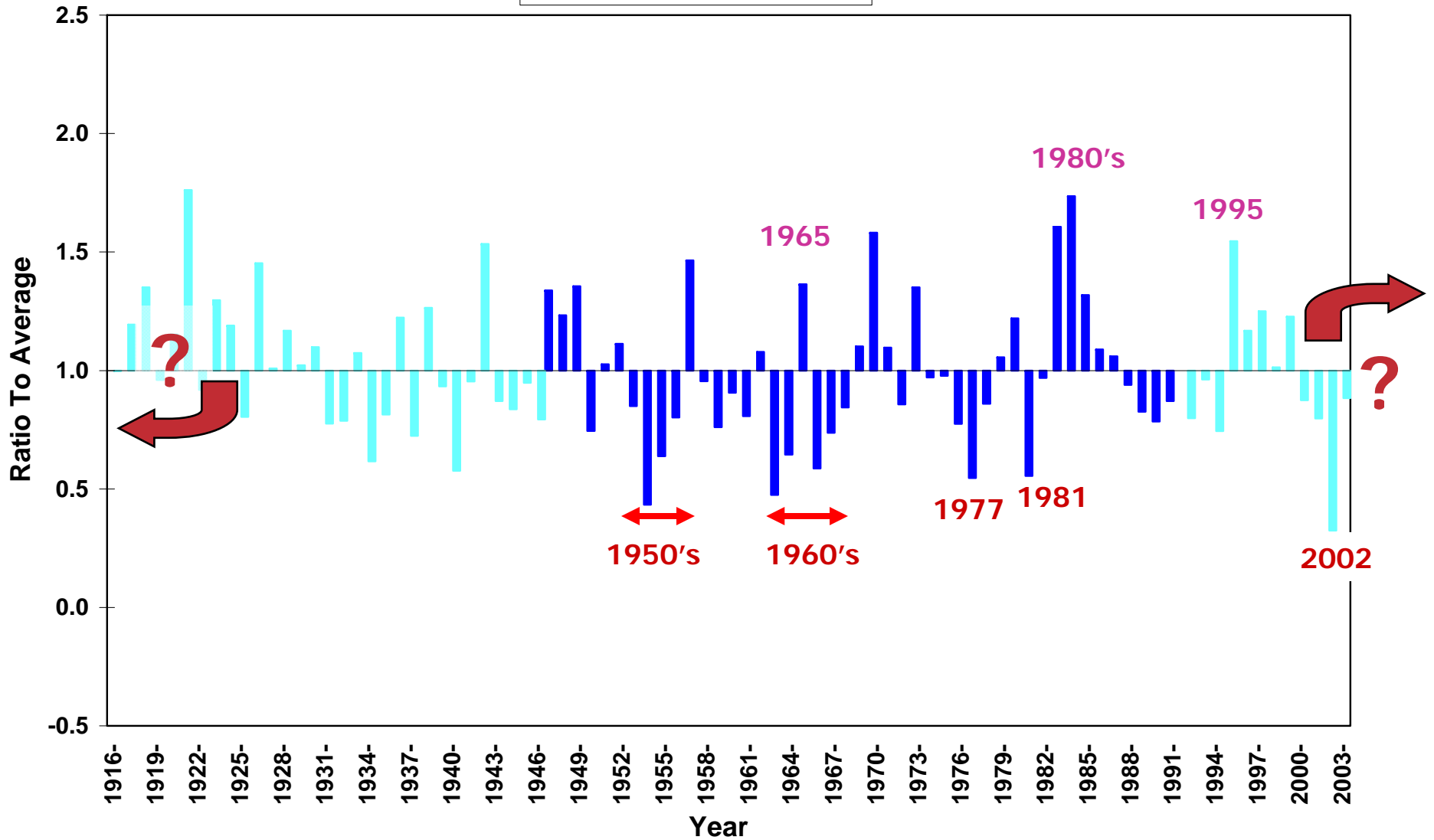
Platte and Colorado Simulation Model PACSM

- ❖ **Integrated system of computer programs that simulate stream flows, reservoir operations and water supply in the South Platte and Colorado River basins.**
- ❖ **Includes many water supply systems, etc.**
- ❖ **Hydrologic Period: 1947 – 1991**
 - **Includes the mid-1950's drought**
 - **Daily data, 450 locations**

Estimated Weighted Total Of Four Stations 1916 - 2003

(Nodes 4250, 2580, 3750, and 50900)

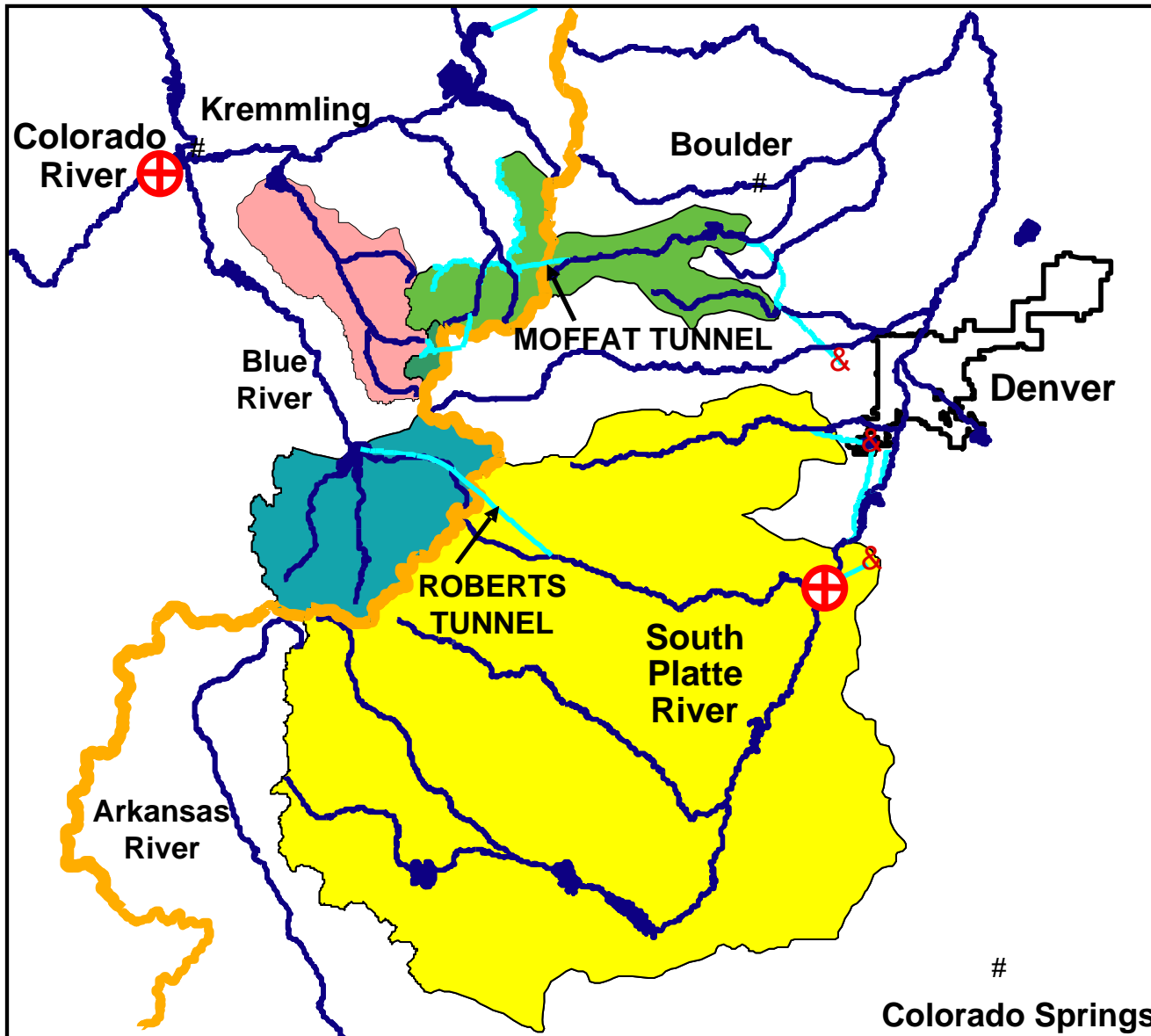
■ PACSM Model ■ Calculated



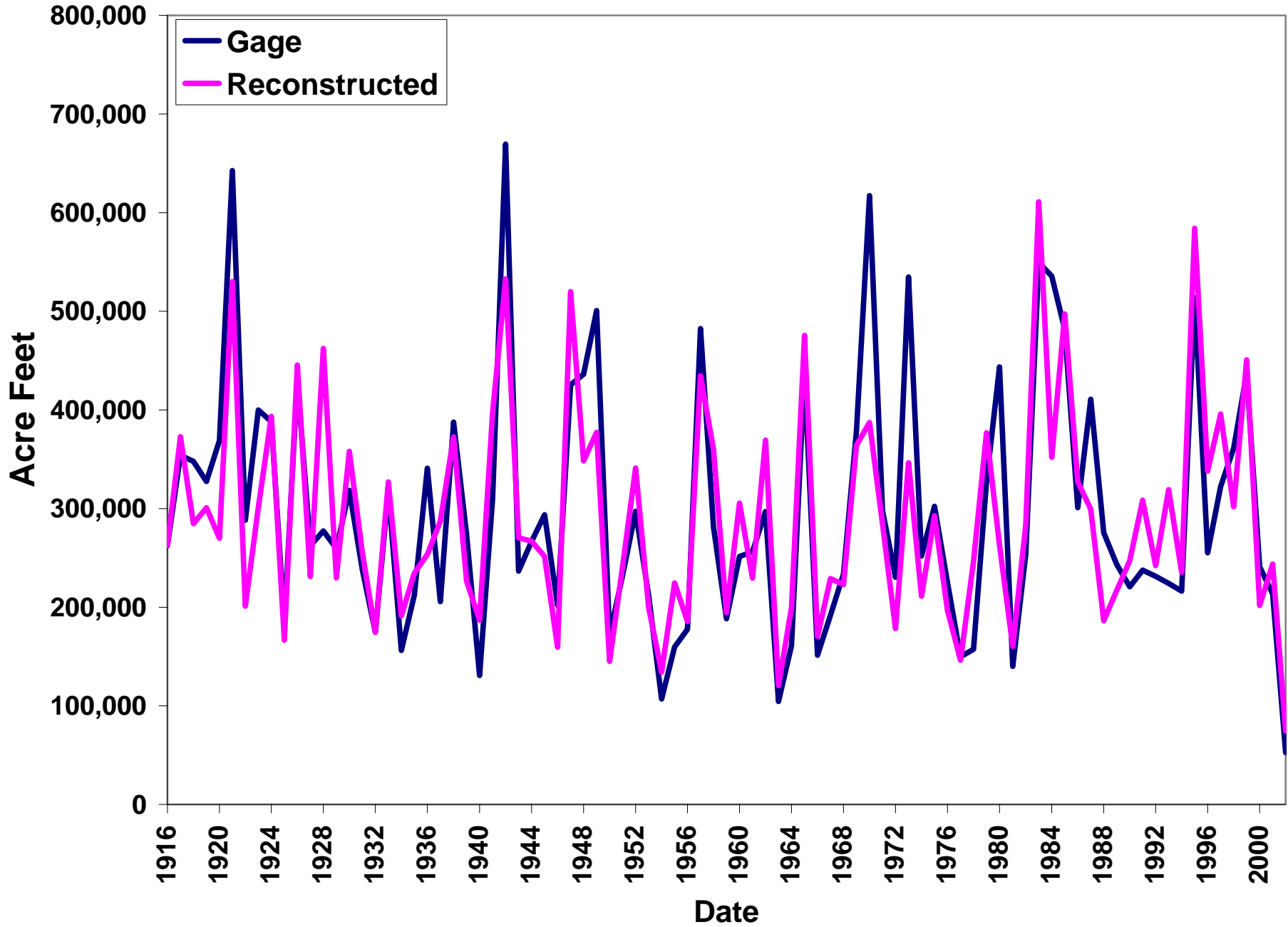
Tree Ring Based Streamflow Reconstructions

- **Use East Slope and West Slope tree ring based stream flow reconstructions.**
 - 1) South Platte River at South Platte**
 - 2) Colorado River at Kremmling Gage**
- **Tree Ring Data 1634 – 1946**
- **Gage Data 1947 – 2005**
- **Modified PACSM to analyze the longer time frame**

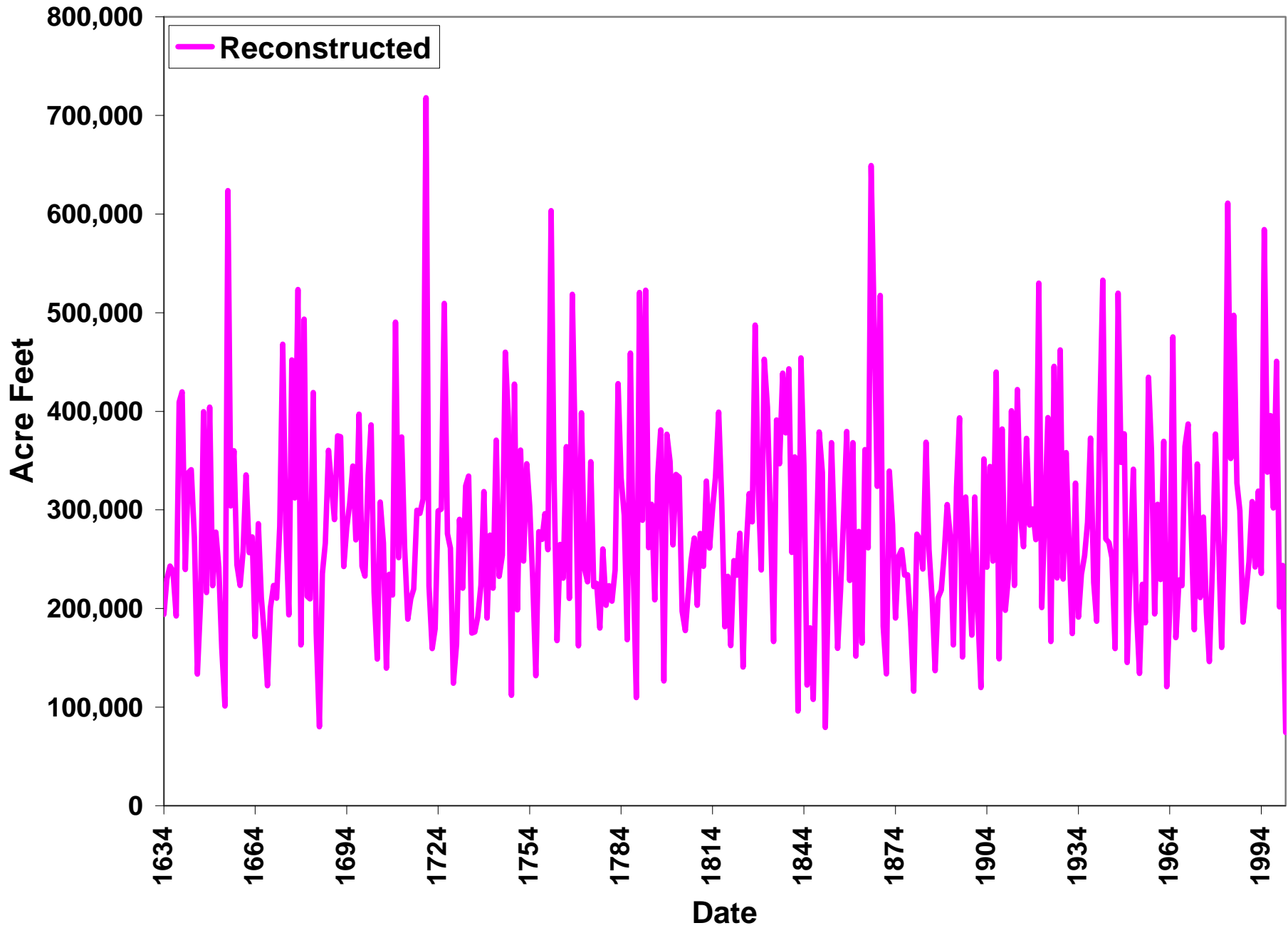
Denver Board of Water Commissioners Water Collection System



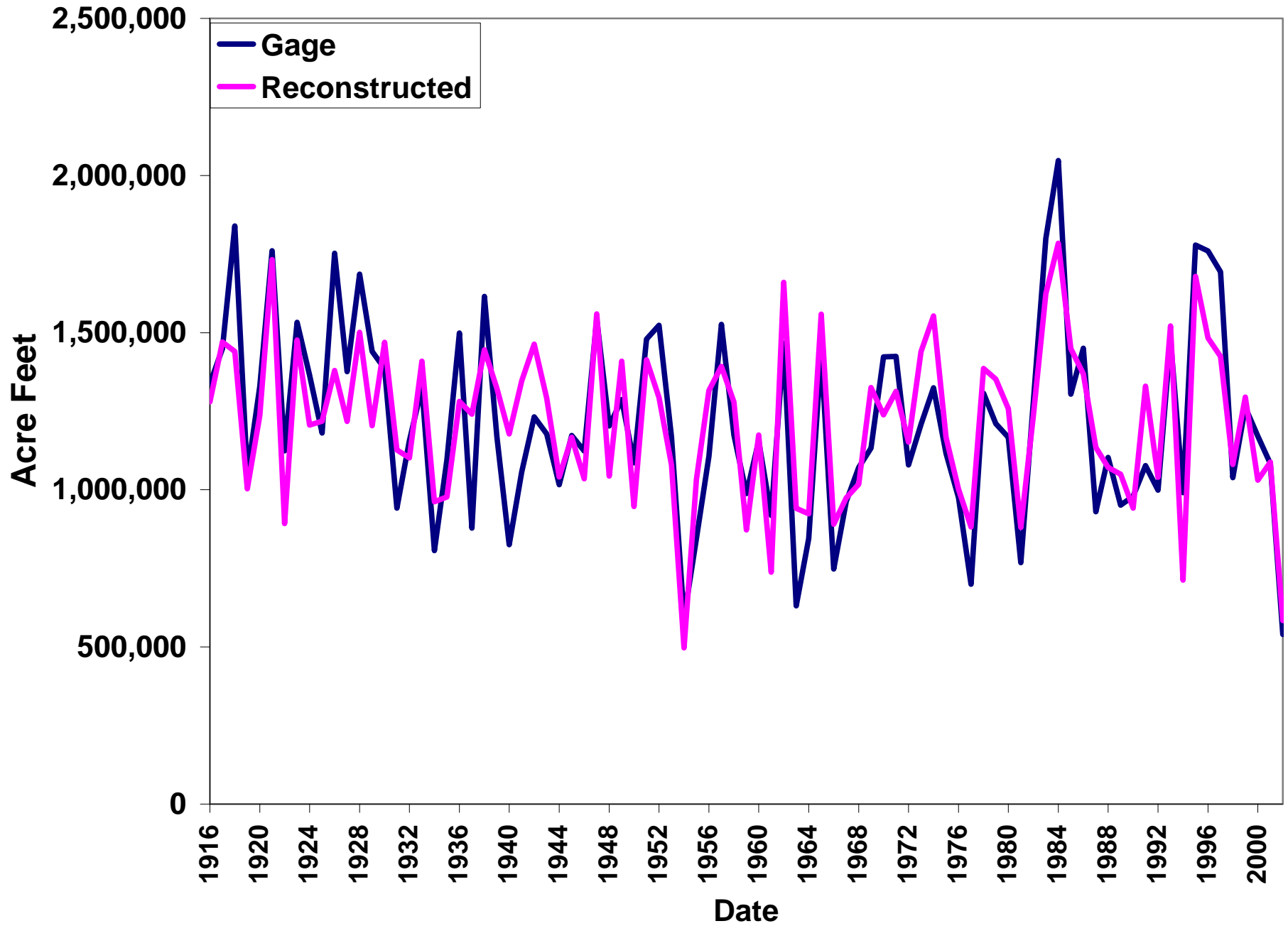
South Platte At South Platte



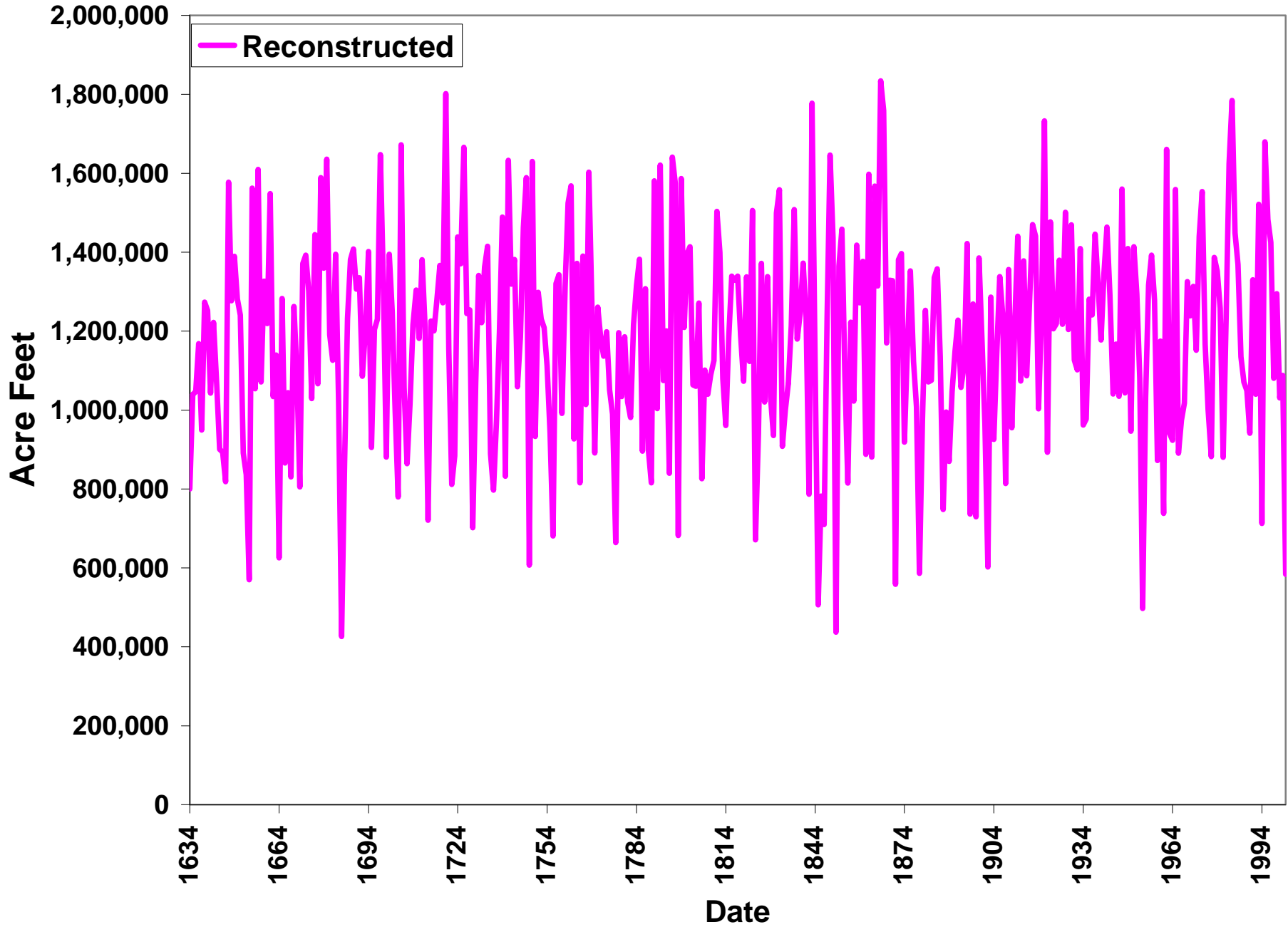
South Platte At South Platte



Colorado River At Kremmling



Colorado River At Kremmling



Tree-Ring Based Streamflow Reconstructions

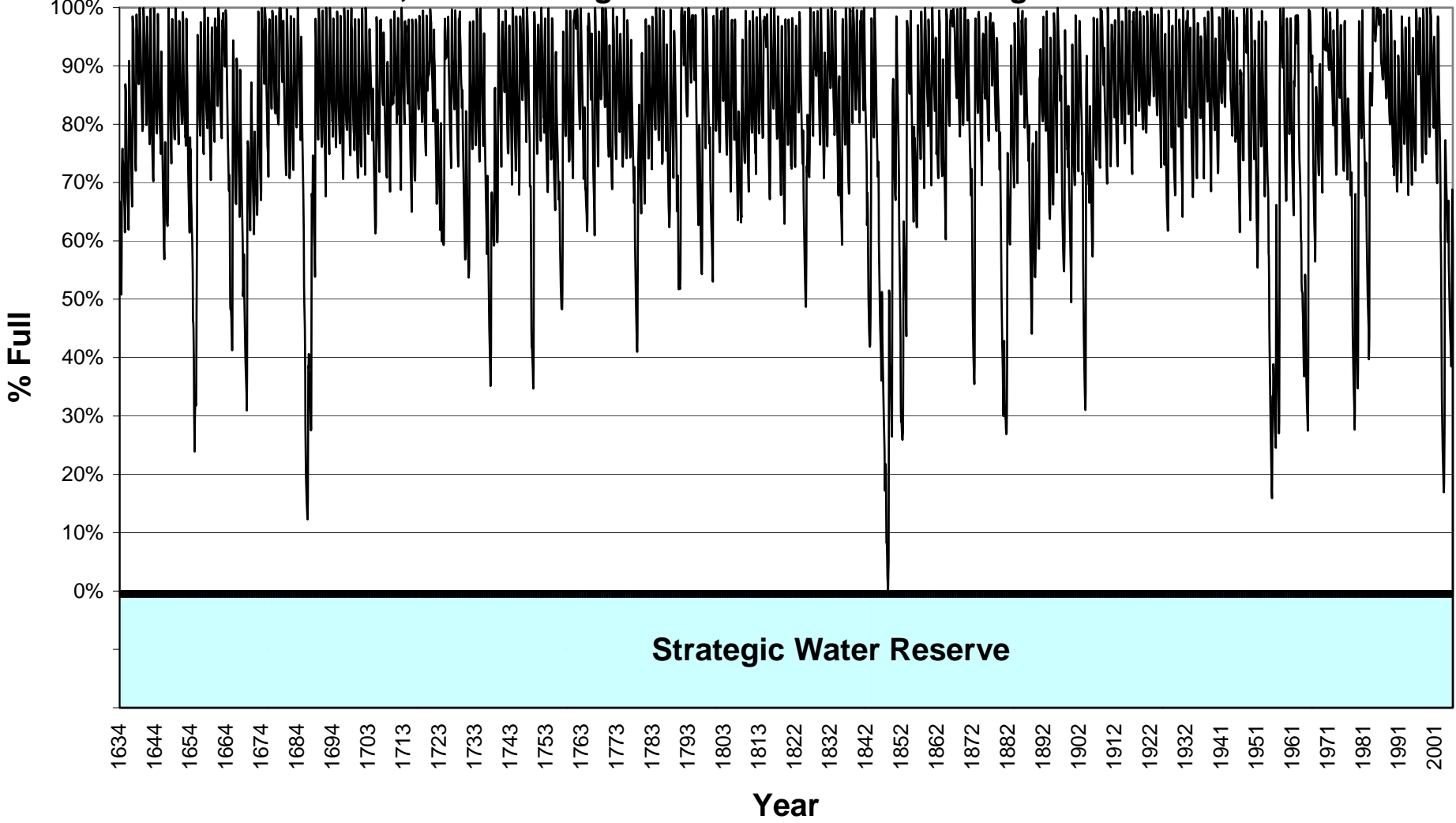
- **Match “Year Type” for East Slope and West Slope**
 - **Each tree ring year is represented by one of 45 model years with known daily hydrology (e.g., 1963 similar to 1655 on West Slope)**
 - **Ratio extreme dry years from driest year in 45-year model period**
 - **Ratio extreme wet years from wettest year in the 45-year period**
- **Assemble data files as new sequences of model years**
- **Use PACSM to simulate entire period, currently 1634-2005**
 - **Determine what level of demand could be met through all tree ring years**
 - **Determine what level of demand could be met during various dry sequences and corresponding recurrence intervals**

After

Denver Water Reservoir Contents (1634-2005)

Water Supply: 345,000 af

Includes 30,000 af Strategic Water Reserve and Drought Restrictions



Limitations of Using Tree Ring-based Reconstructions

- **Although correlations between tree rings and streamflow are generally good, reconstructions are not as sensitive in the extreme wet or dry years.**
- **Using mean values for reconstructions, confidence intervals not used.**
- **From only one number (annual flow), we assume an entire year of daily data.**
- **From one East Slope and one West Slope location, all 450 model nodes are adjusted.**

Major Assumptions

- **No Drought Period Worse Than Tree Ring-based Period**
- **No Adjustments for Potential Global Climate Change**
- **Perfect Operation of the Water Supply System**
- **No Loss of Water Rights**
- **Estimate of Future Demand is Not Exceeded**

