



Nebraska  
Department of Natural Resources

**WATER TODAY. WATER TOMORROW.**

Providing the sound science and support for managing  
Nebraska's most precious resource.

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**WATER SCIENCE:  
STREAM AND AQUIFER DEPLETION**

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JESSE BRADLEY, P.G., NATURAL RESOURCES PROGRAMS DIRECTOR  
Nebraska Department of Natural Resources

# Overview

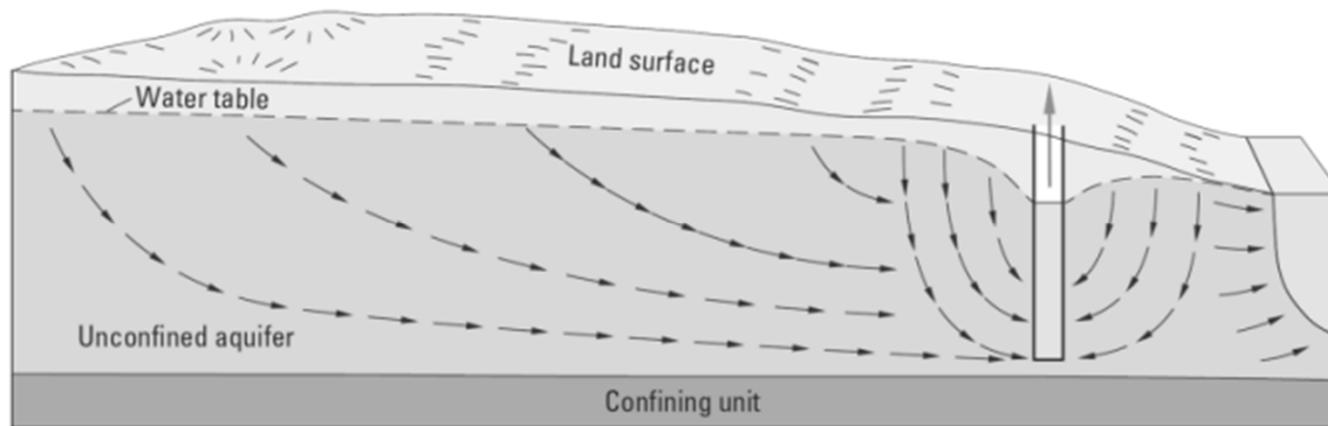
- Stream and Aquifer Depletion
  - The effects of well location on stream depletion
  - Review of well depletion zones
  - Wells in the Republican Basin through time
  - Stream depletion
  - Aquifer depletion

# WELL LOCATION AND STREAM DEPLETION

## Terminology:

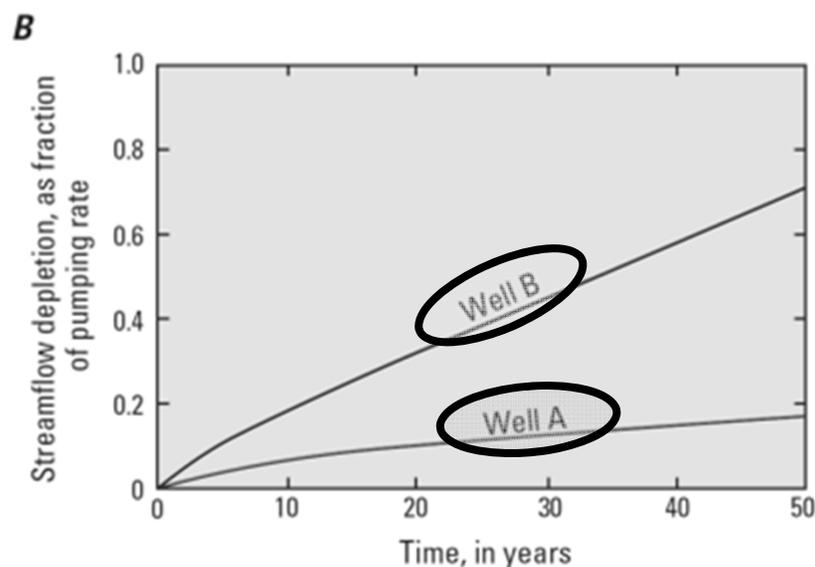
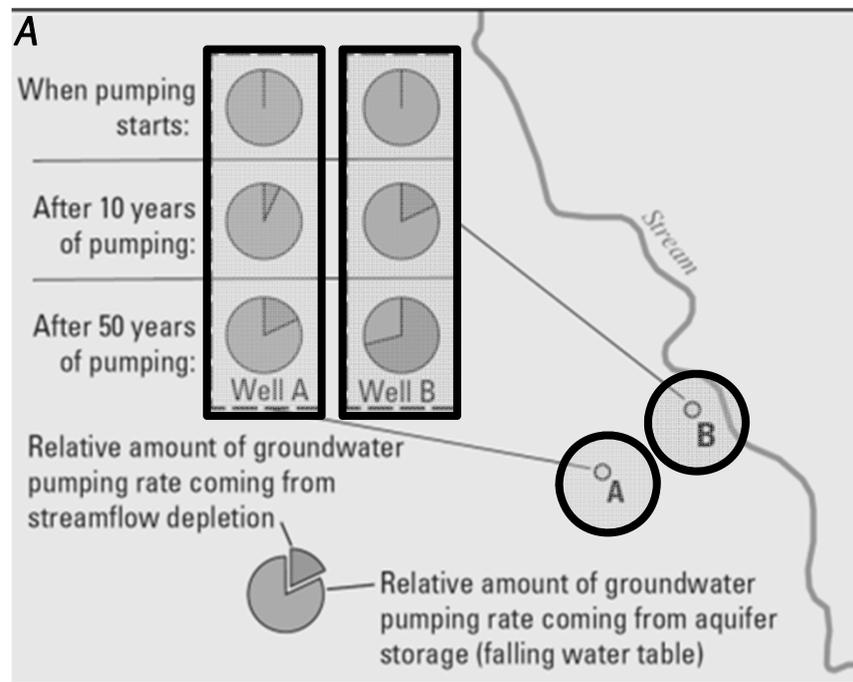
# Cone of Depression/Hydraulic Gradient

- As a well begins to pump water from an aquifer:
  - Groundwater levels around the well decline, creating a cone of depression in the water levels around the well
  - A hydraulic gradient is now present between the normal water table and the aquifer around the well
- The hydraulic gradient established within the cone of depression forces water to move from the aquifer into the well



## Effects of Well Location on the Rate of Stream Depletion

	Well A	Well B
Proximity to stream	Farther	Closer
When cone of depression reaches stream	Later	Sooner
Length of time groundwater storage is a source of water to the well	Longer	Shorter
Streamflow depletion becomes primary source of water	Later	Sooner

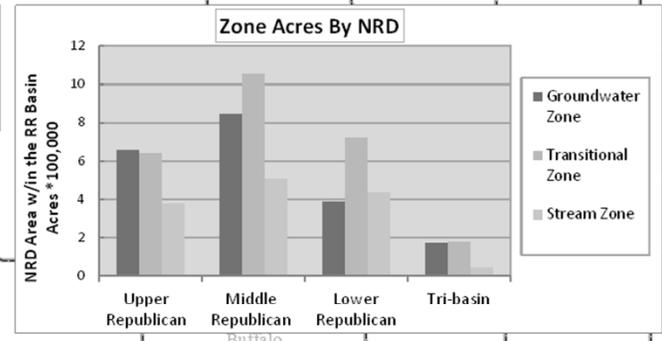
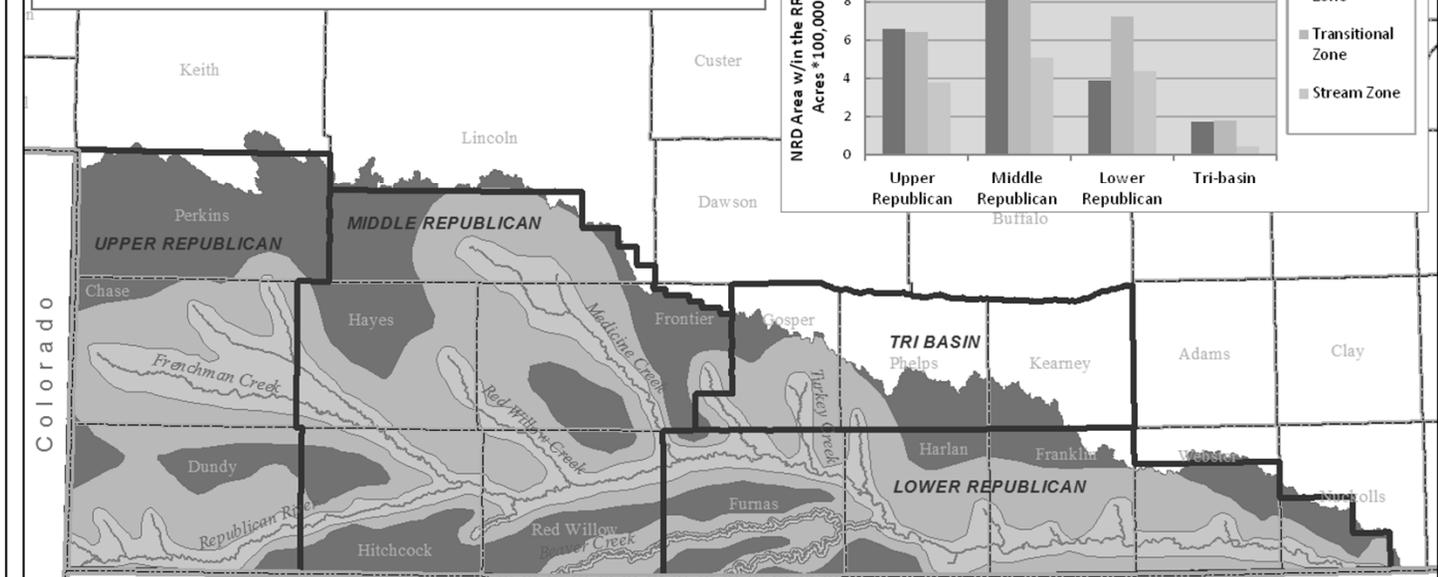


**Questions?**

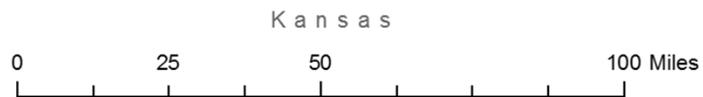


# **REVIEW OF WELL DEPLETION ZONES**

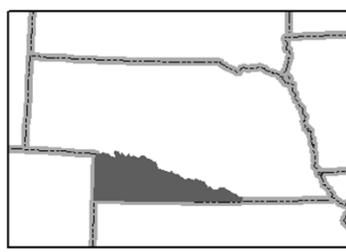
# Republican River Basin Generalized Well Depletion Zones



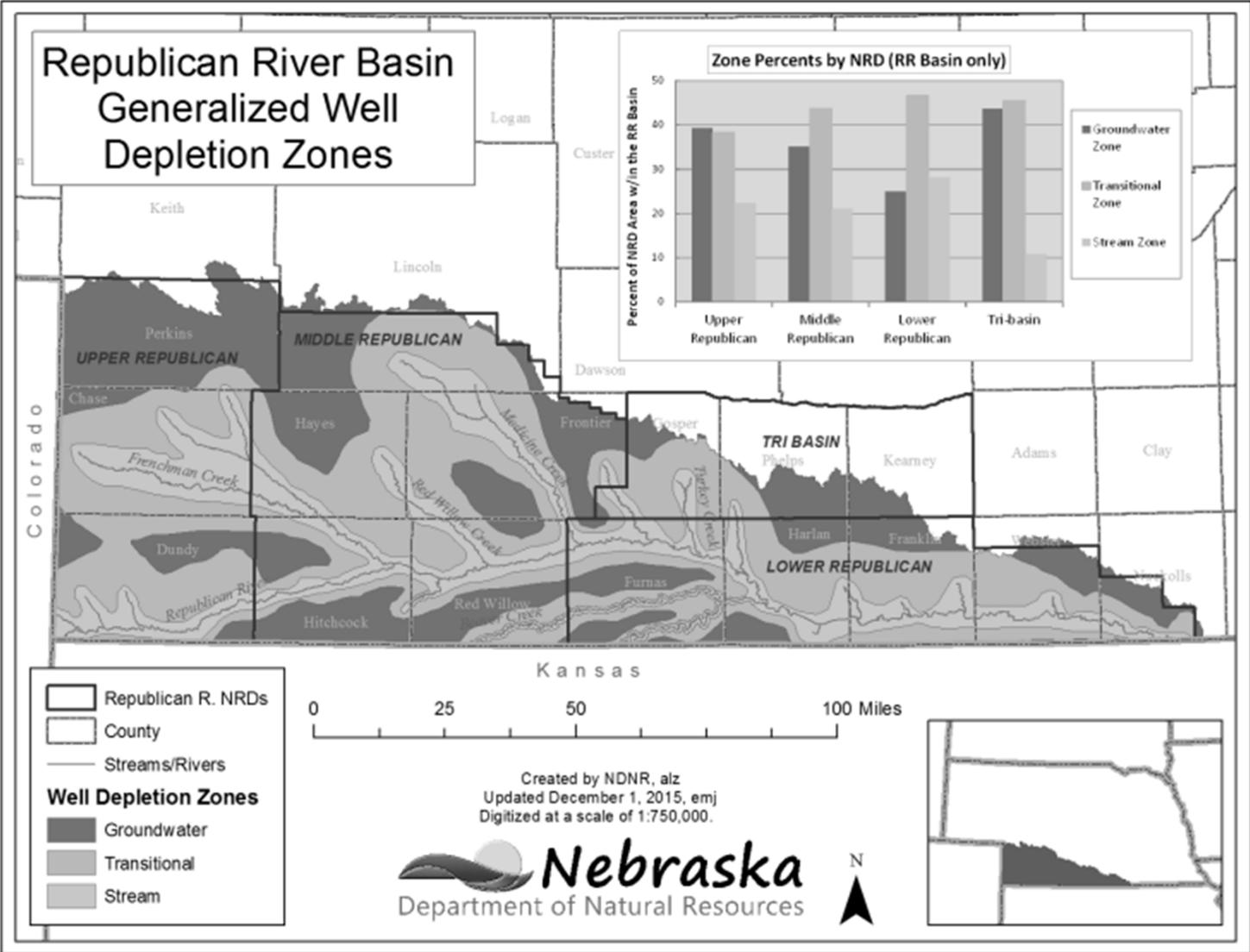
- Republican R. NRDs
- County
- Streams/Rivers
- Well Depletion Zones**
- Groundwater
- Transitional
- Stream



Created by NDNR, alz  
Updated December 1, 2015, emj  
Digitized at a scale of 1:750,000.



# Republican River Basin Generalized Well Depletion Zones

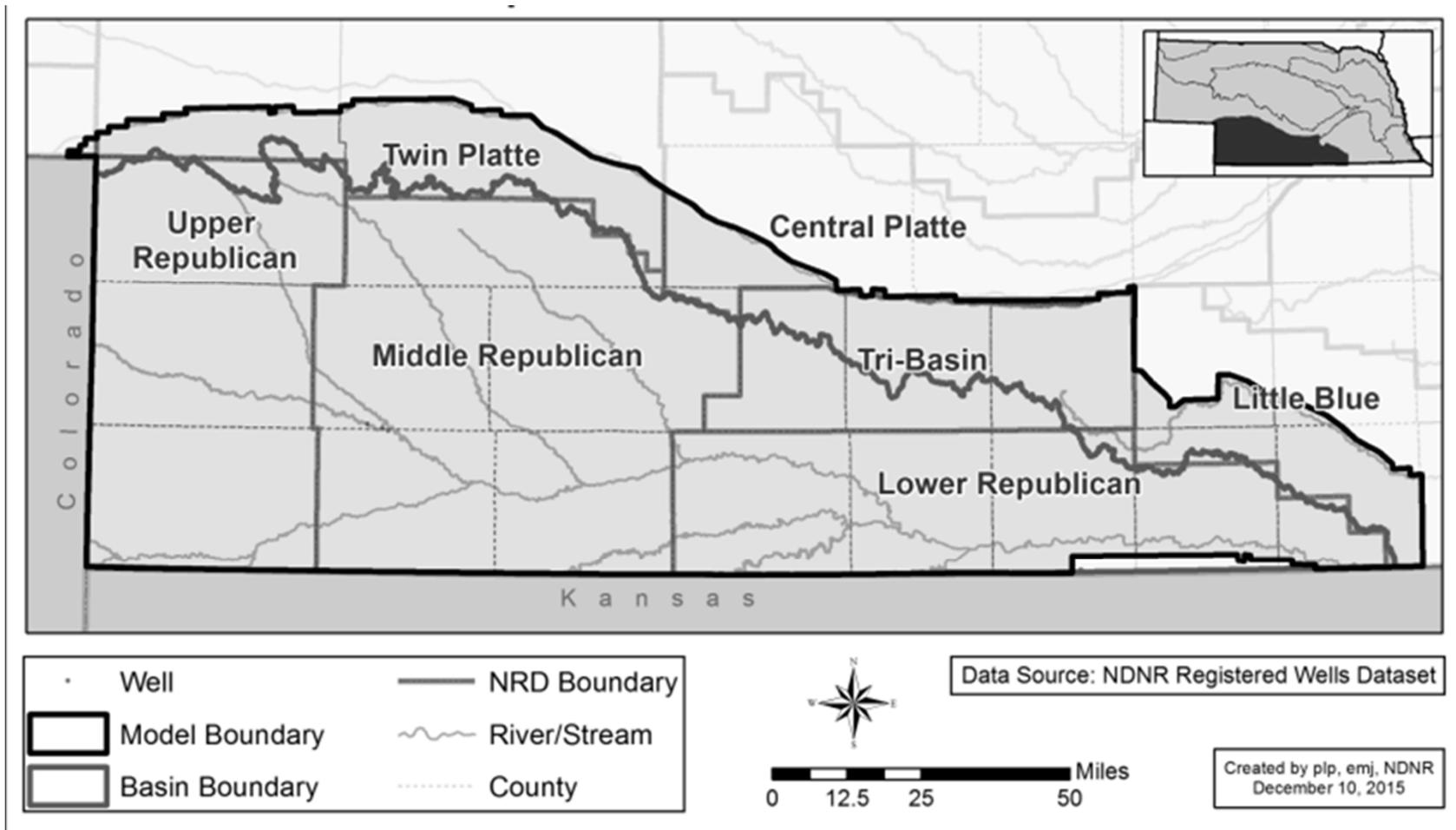


**Questions?**

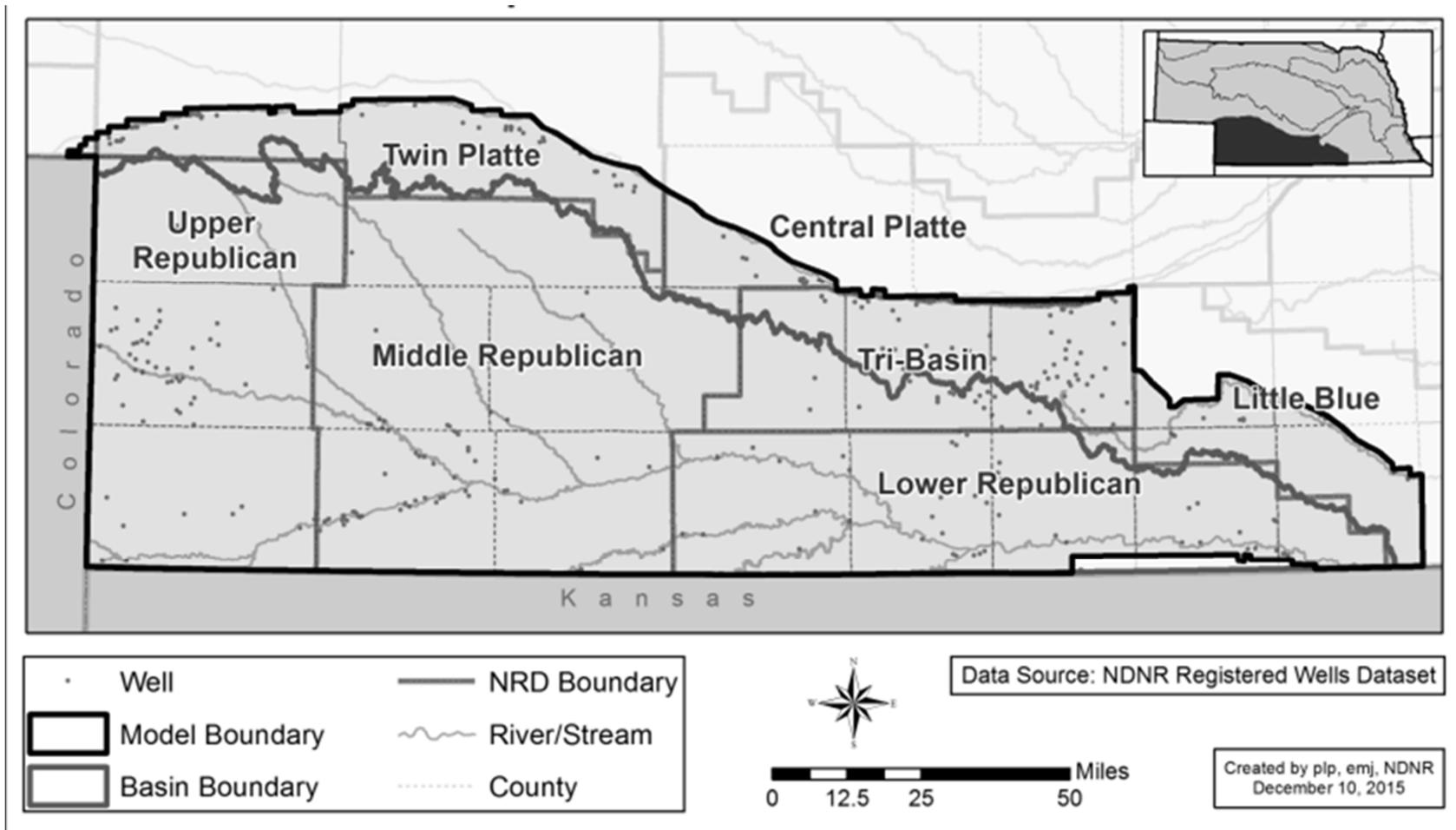


# **WELLS IN THE REPUBLICAN BASIN THROUGH TIME**

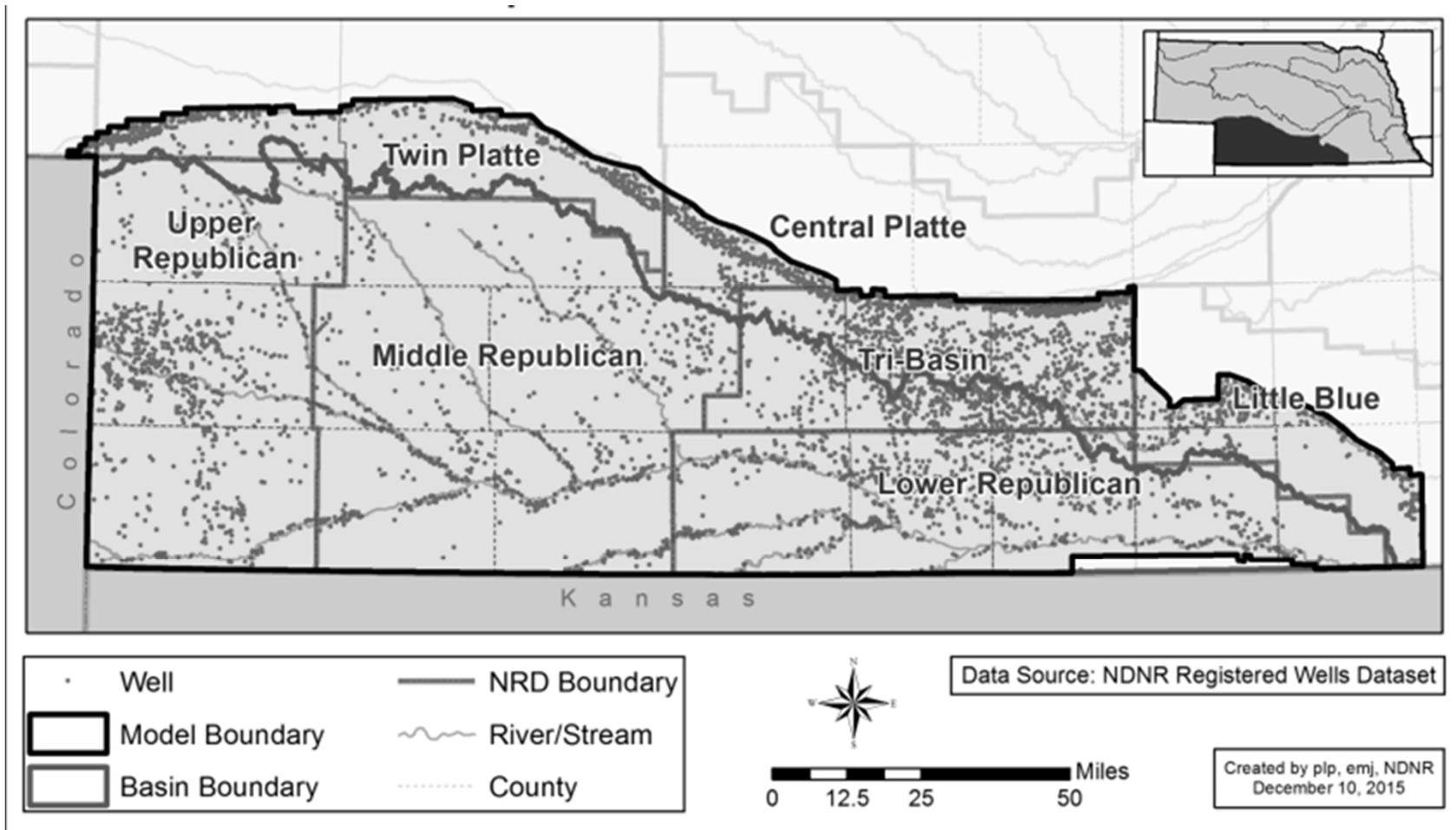
# 1940 Republican River Model Area Wells



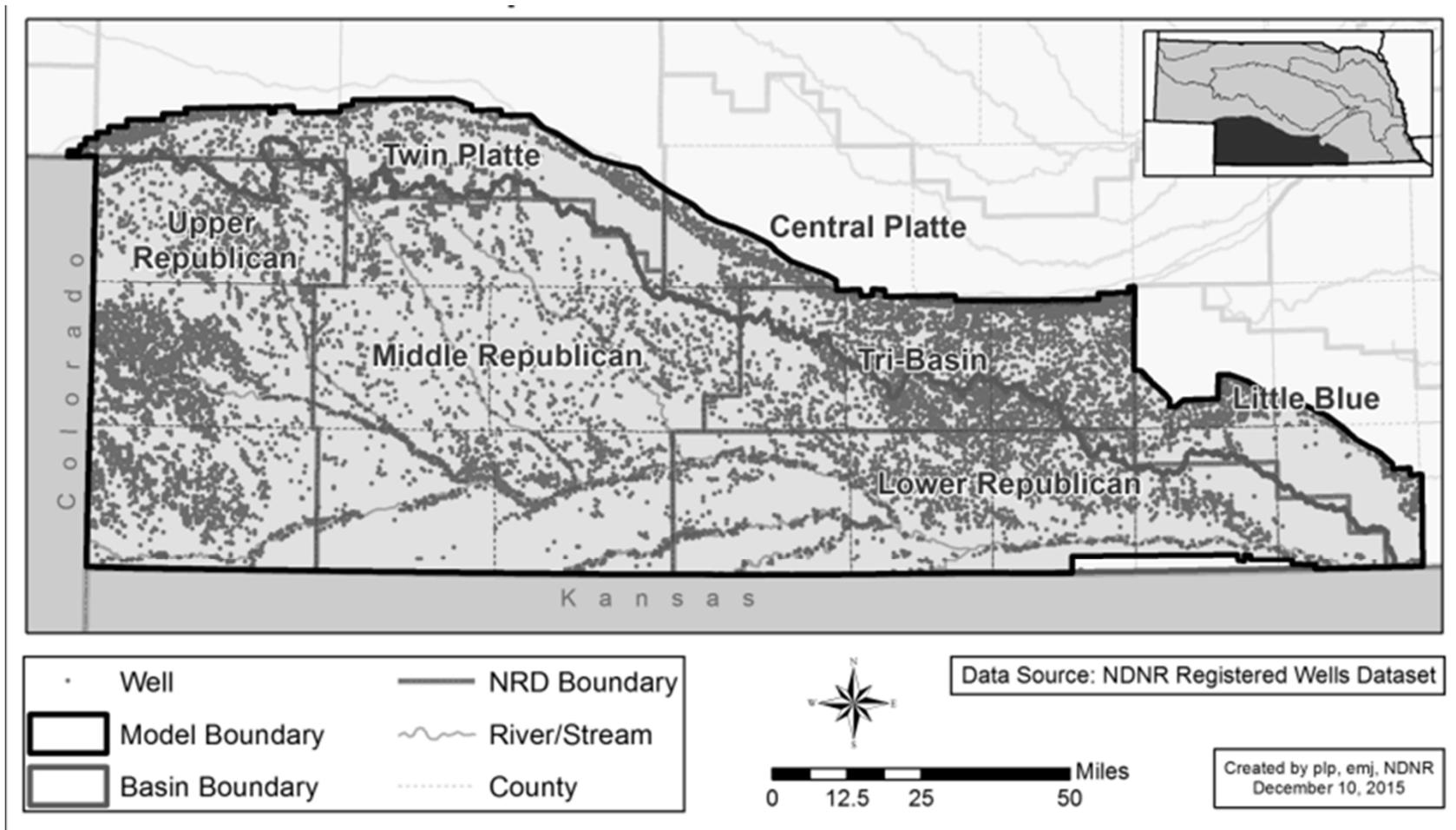
# 1955 Republican River Model Area Wells



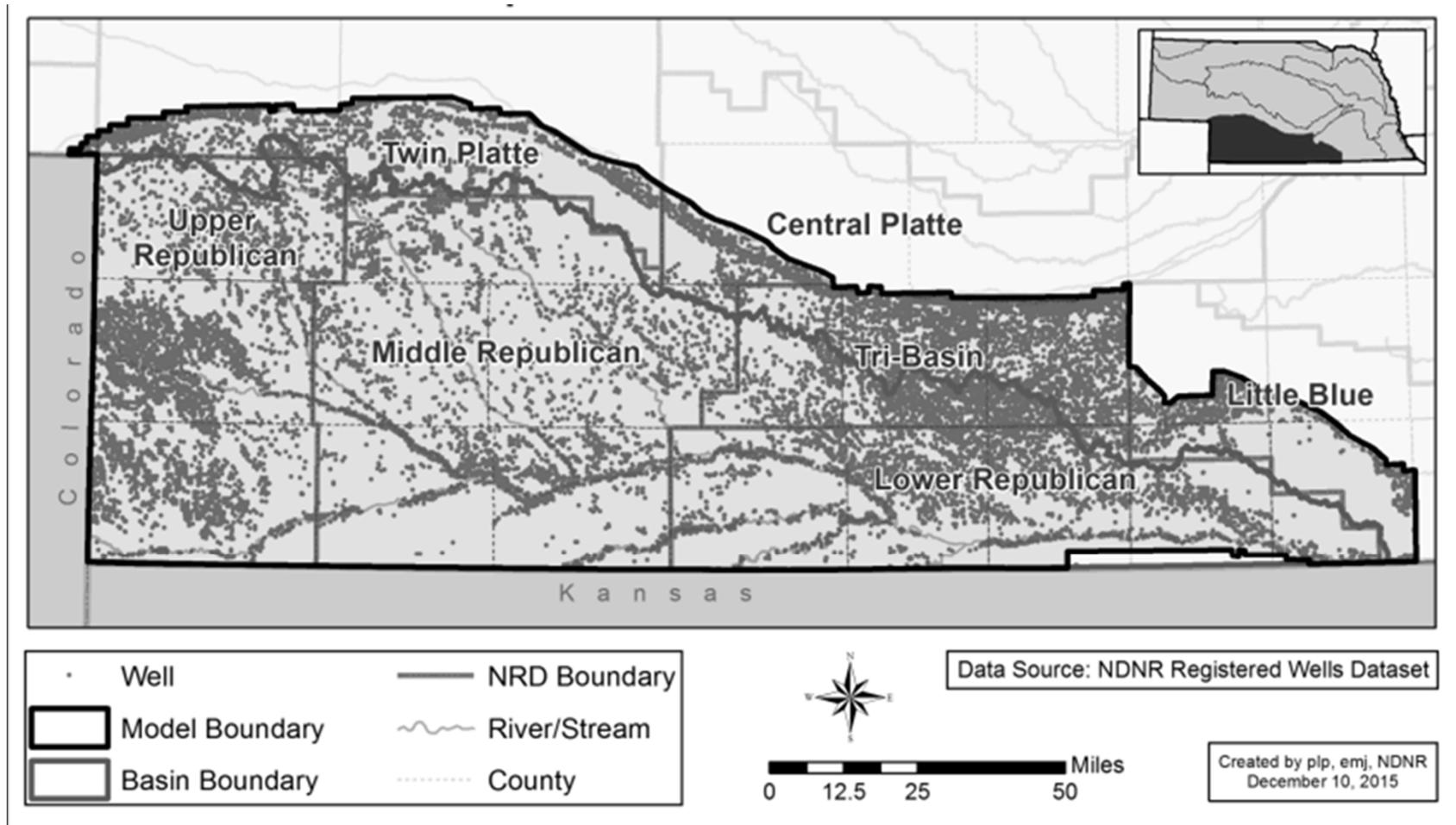
# 1970 Republican River Model Area Wells



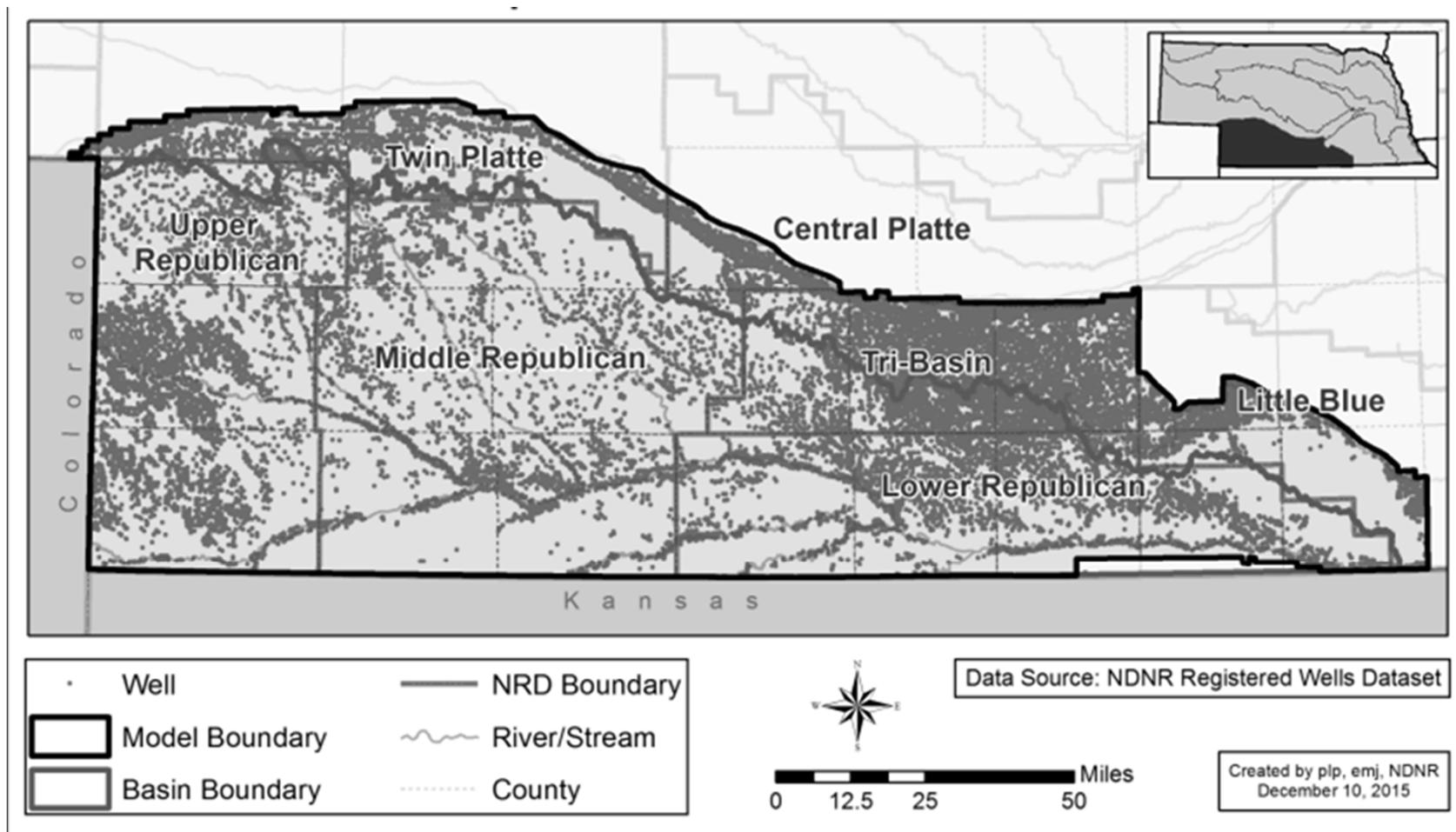
# 1985 Republican River Model Area Wells



# 2000 Republican River Model Area Wells



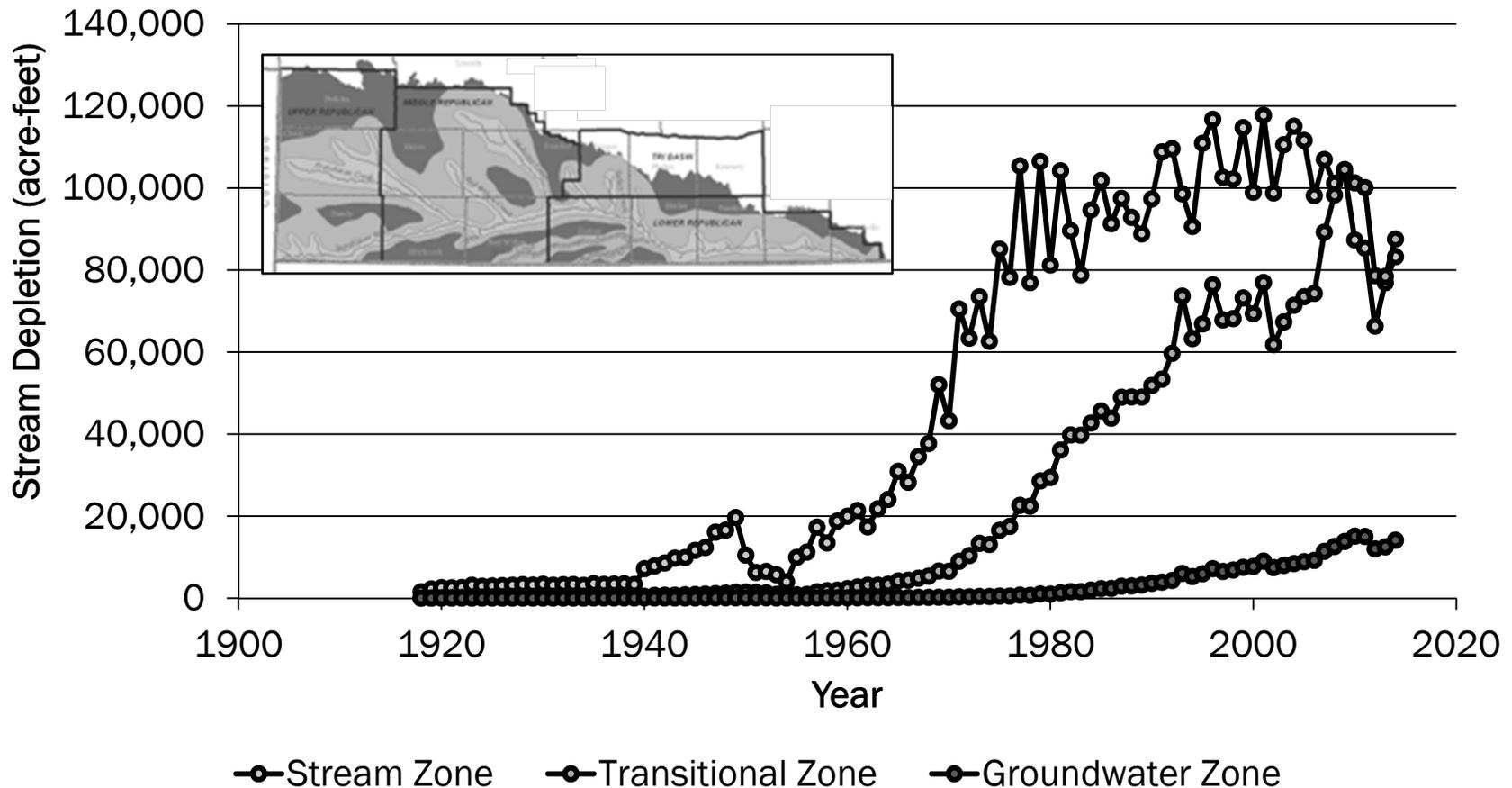
# 2015 Republican River Model Area Wells

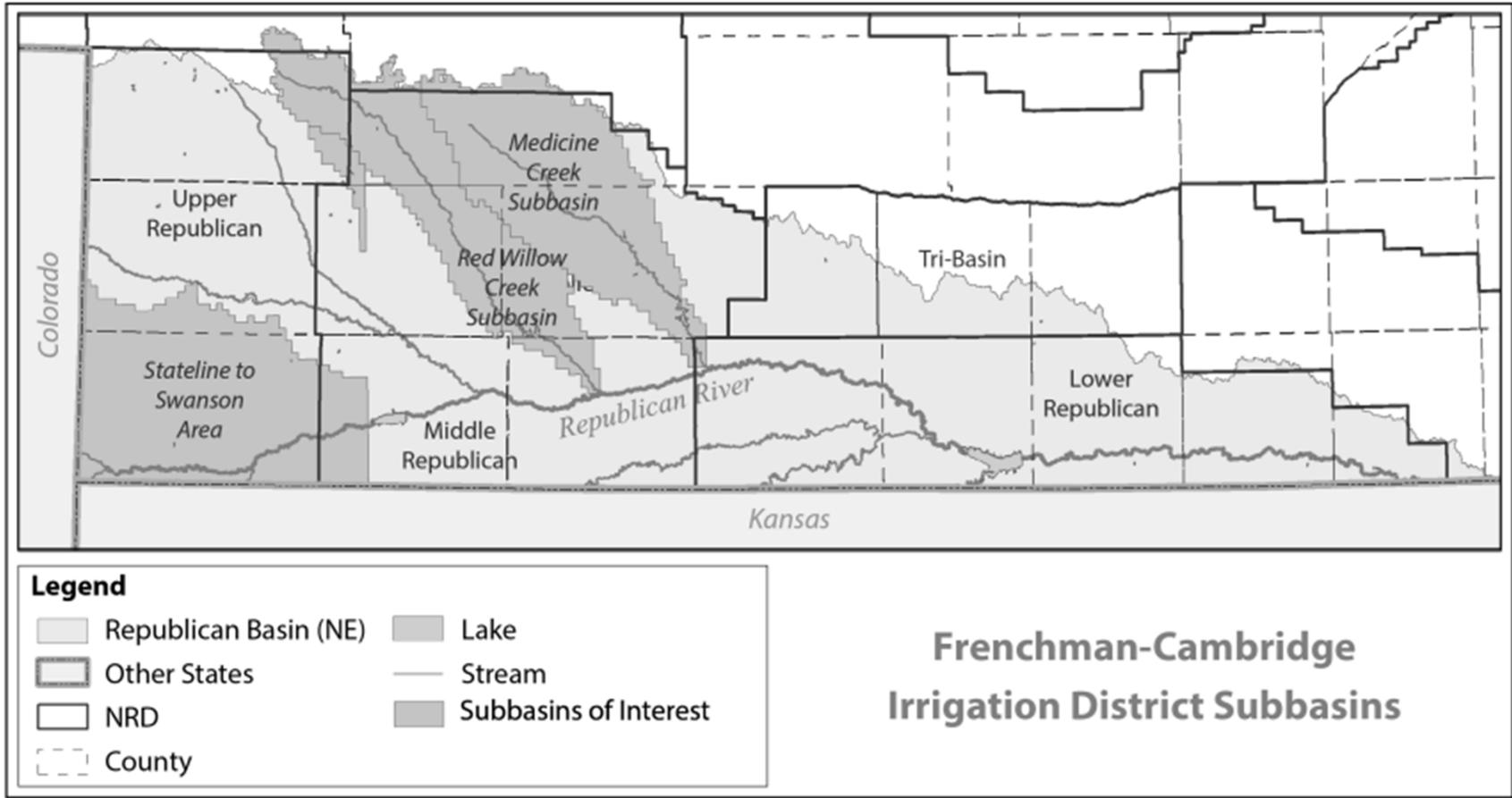


**Questions?**

# STREAM DEPLETION

# Stream Depletions by Well Depletion Zone

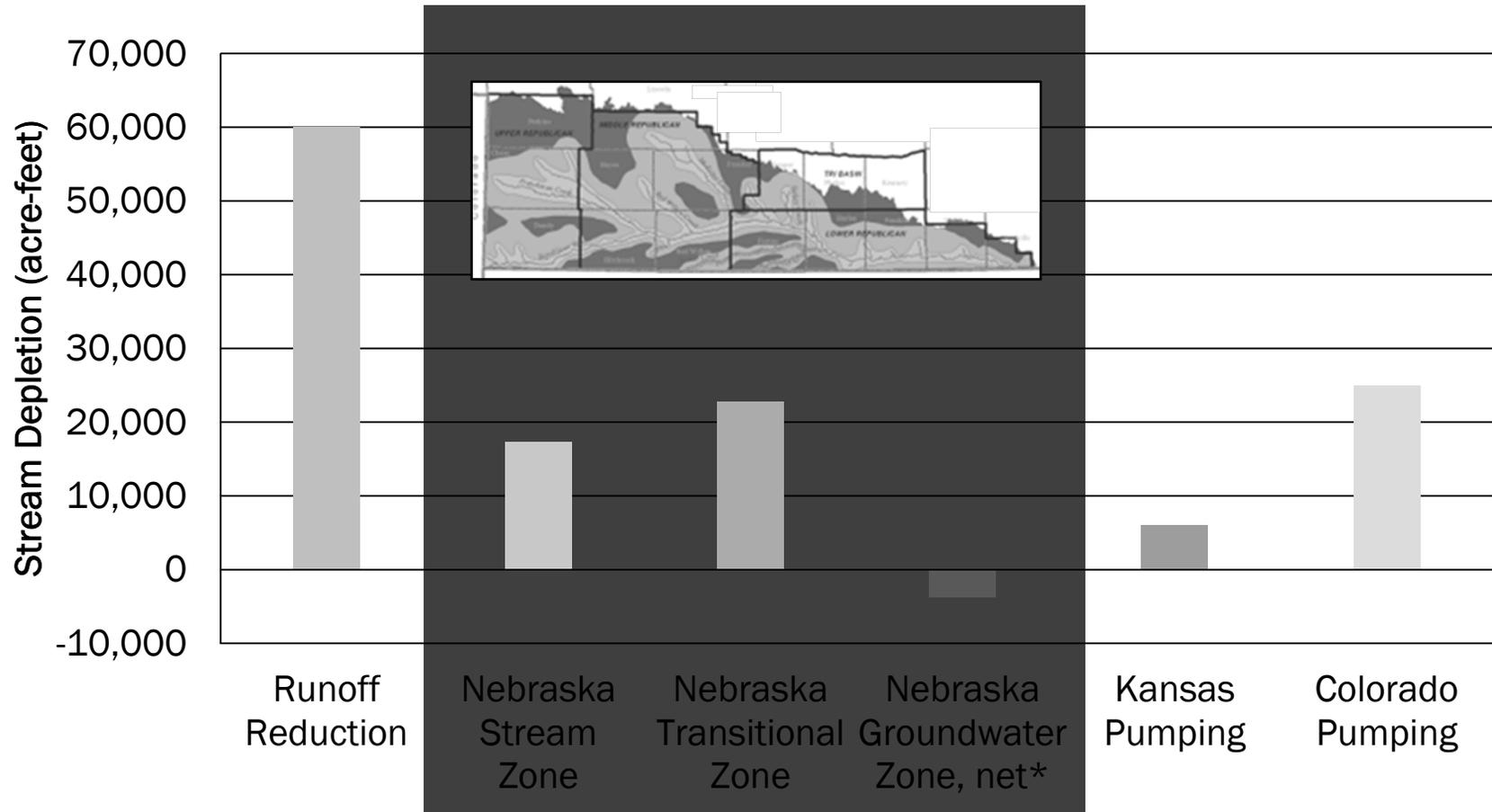




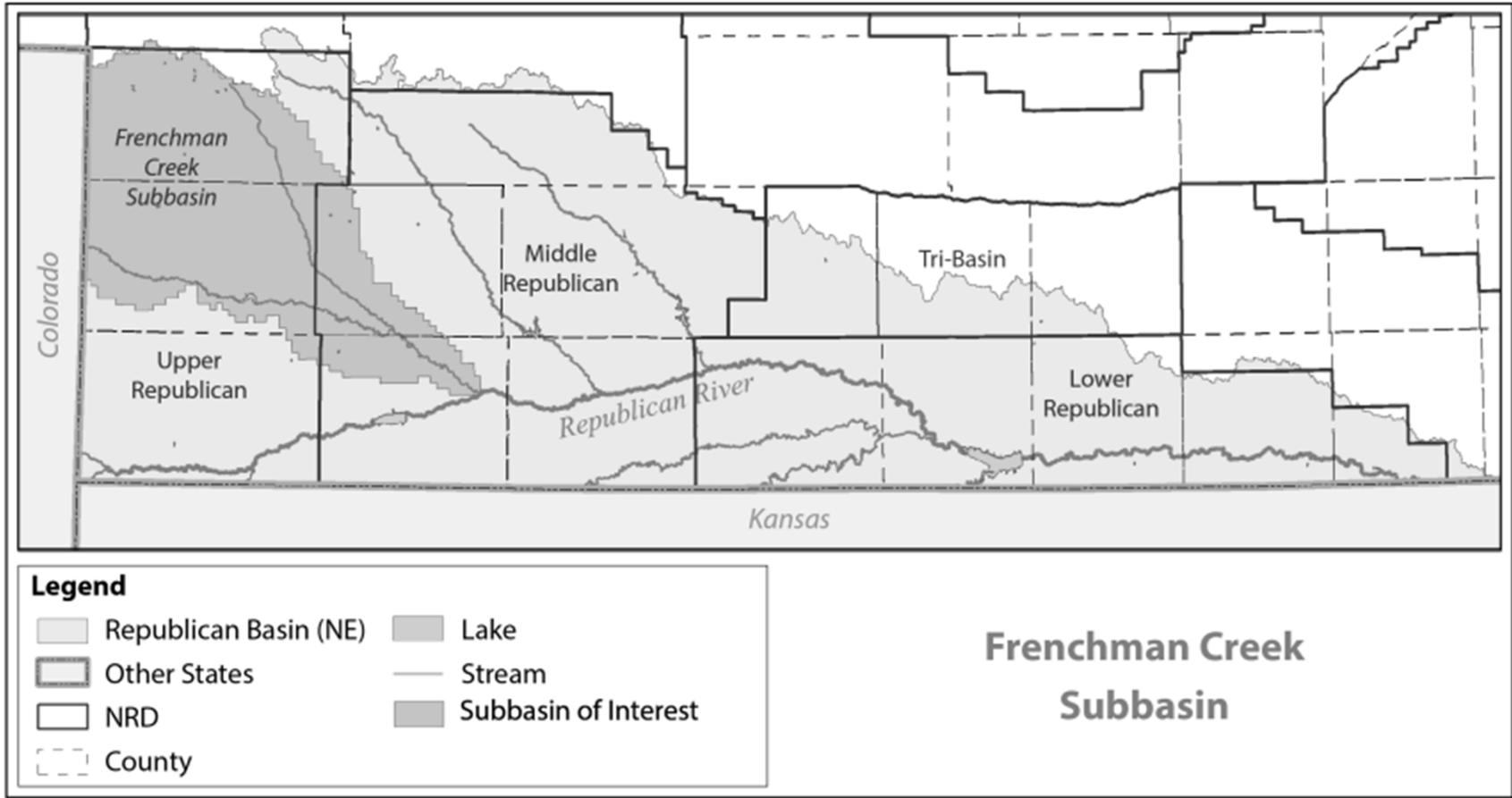
**Frenchman-Cambridge  
Irrigation District Subbasins**

# Impacts above Reservoirs Serving Frenchman Cambridge Irrigation District

Impacts 1950-1964 compared to 2000-2012

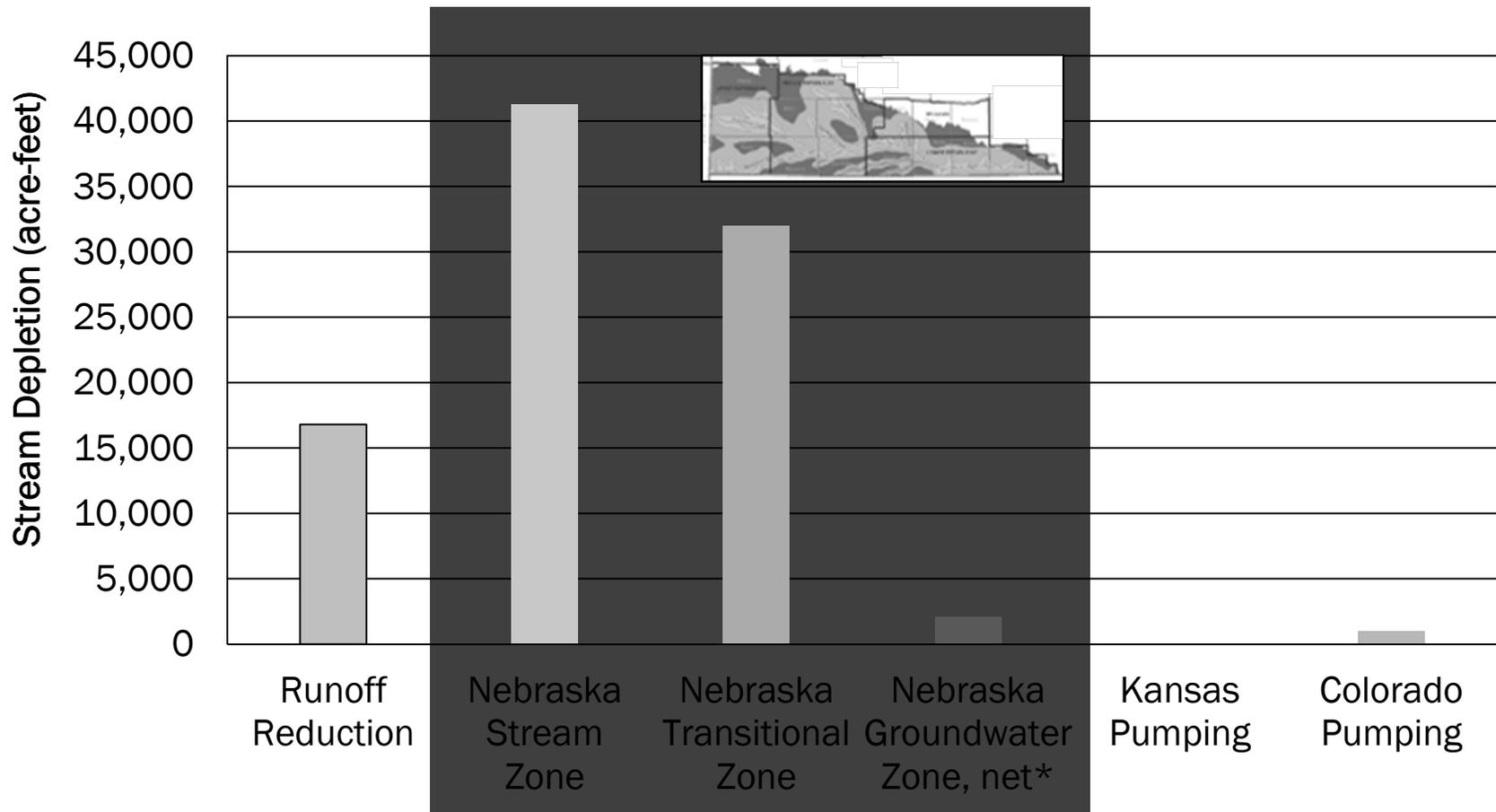


\*Net = Pumping impact minus imported water

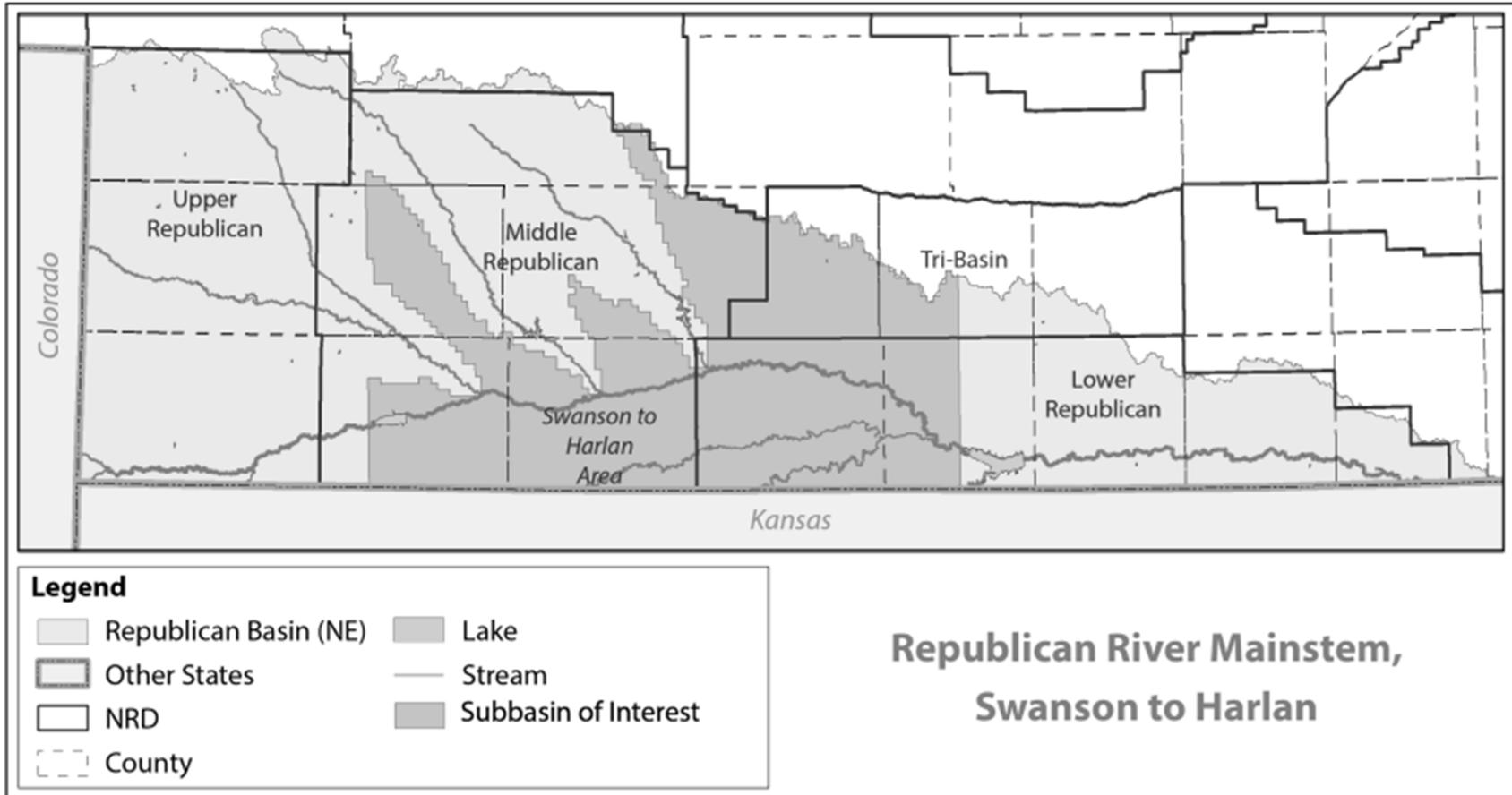


# Impacts to Frenchman Creek Subbasin

Impacts, 1950-1964 compared to 2000-2012

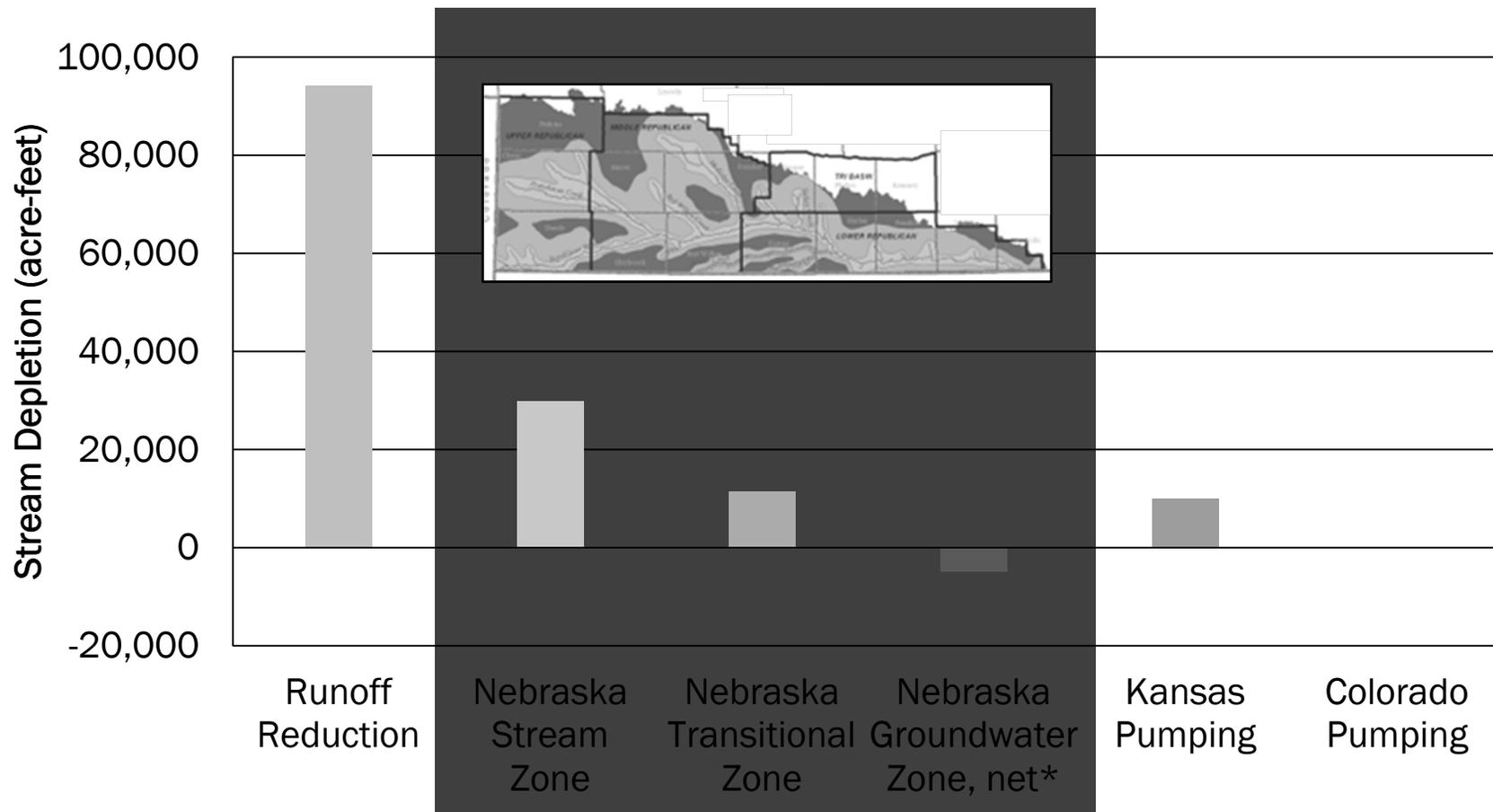


\*Net = Pumping impact minus imported water

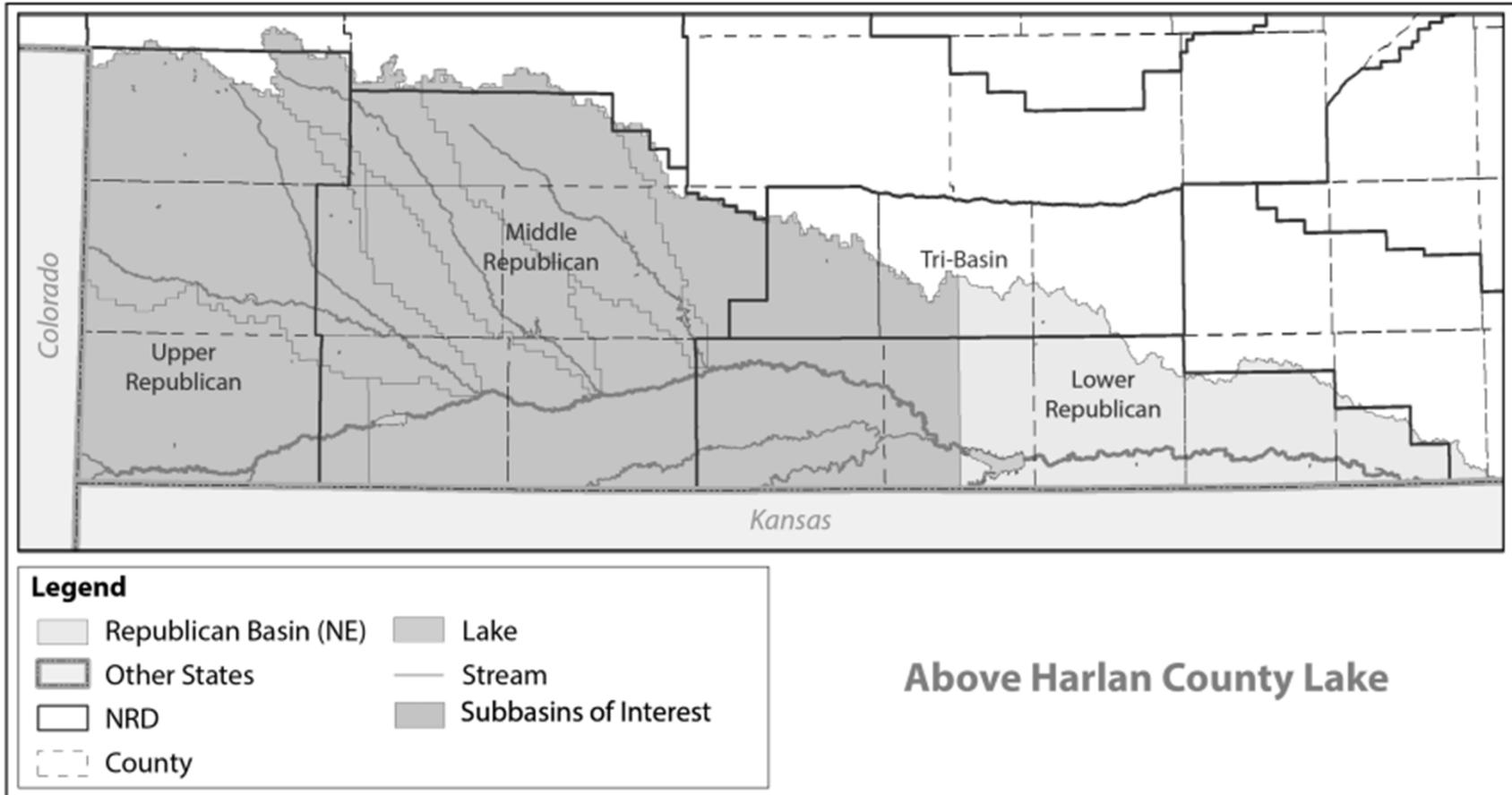


# Impacts to Mainstem, Swanson to Harlan

Impacts, 1950-1964 compared to 2000-2012



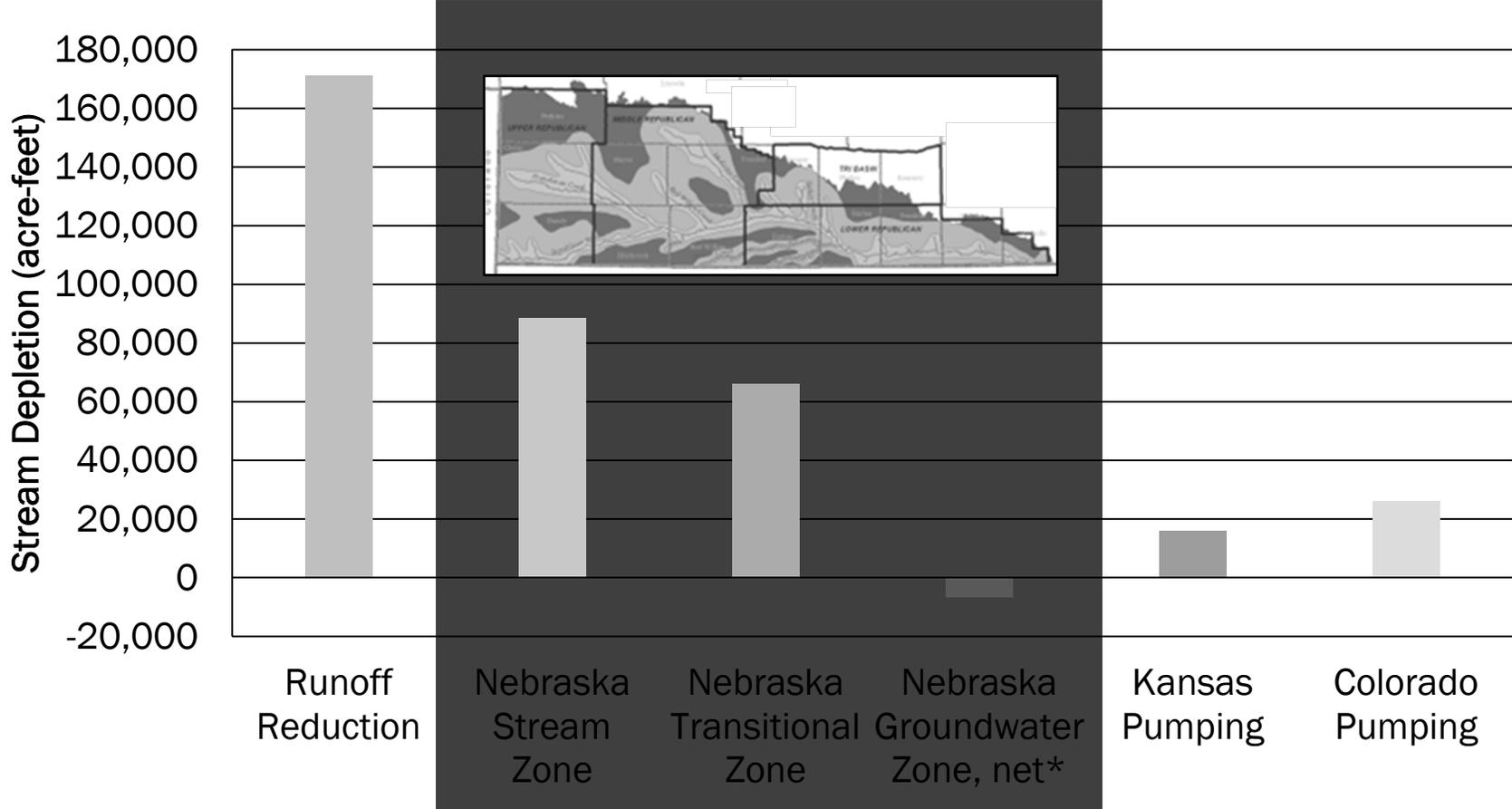
\*Net = Pumping impact minus imported water



**Above Harlan County Lake**

# Total Impacts above Harlan County Lake

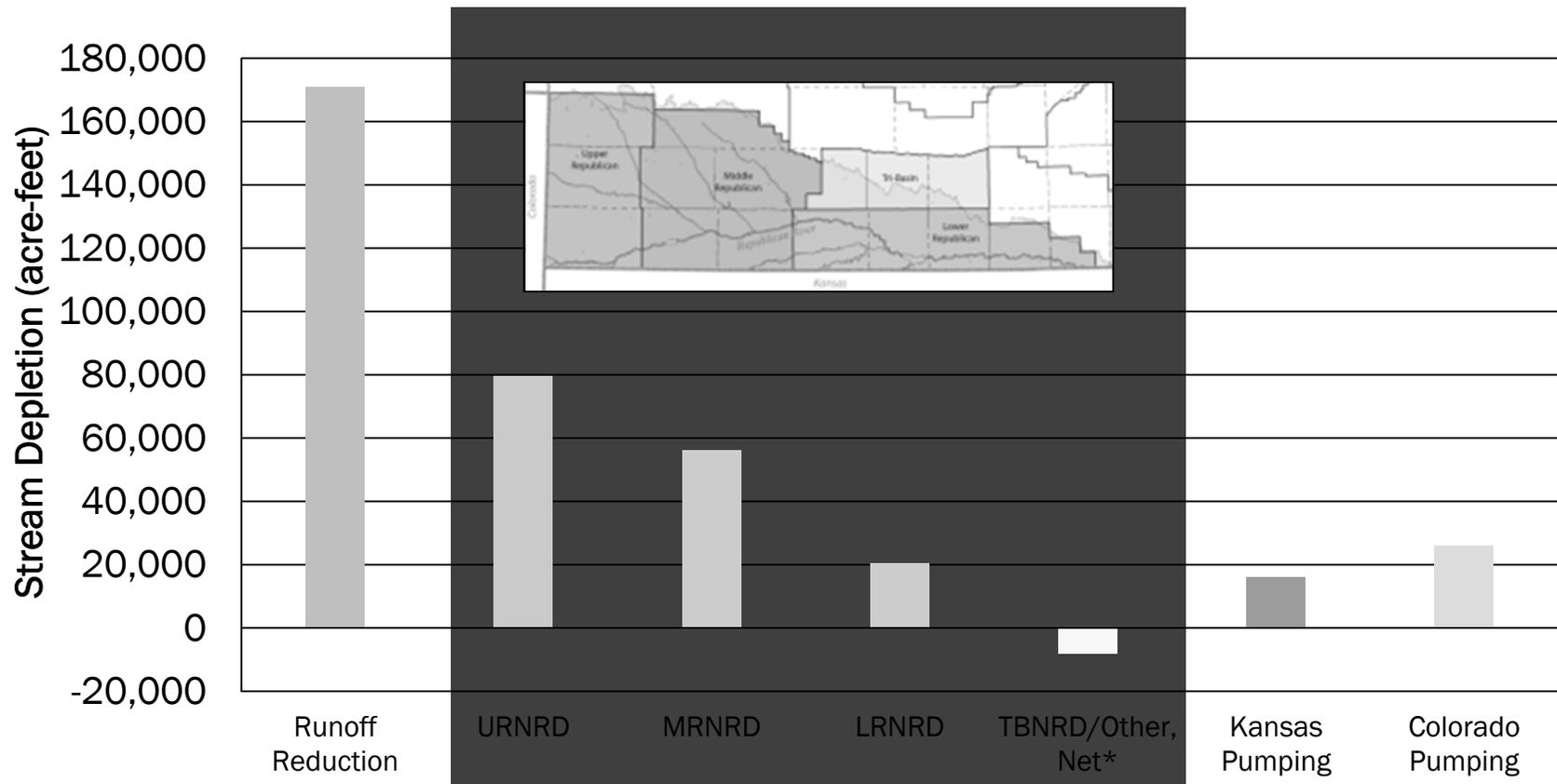
Impacts, 1950-1964 compared to 2000-2012



\*Net = Pumping impact minus imported water

# Total Impacts above Harlan County Lake

Impacts, 1950-1964 compared to 2000-2012



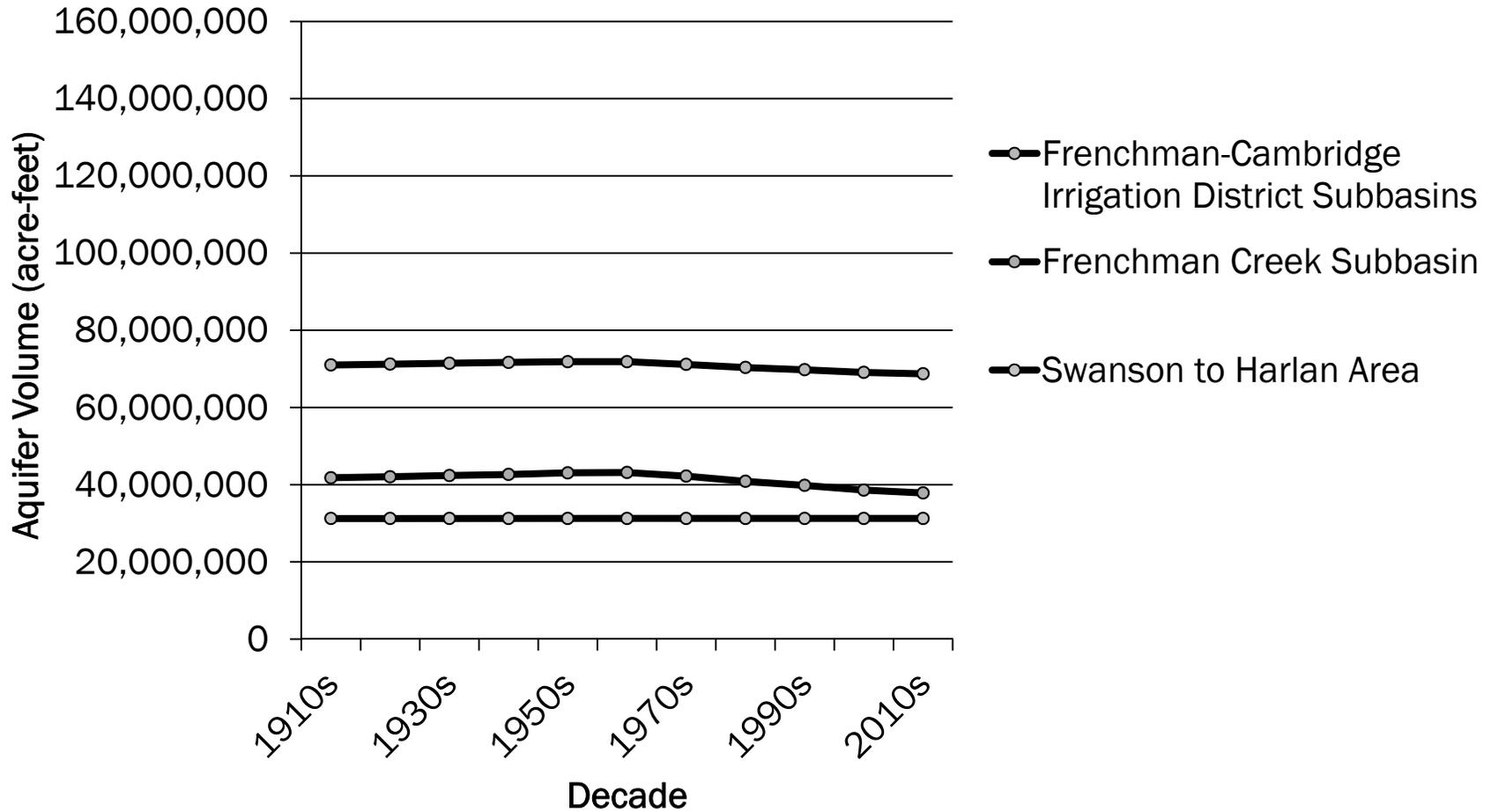
\*Net = Pumping impact minus imported water

**Questions?**

# AQUIFER DEPLETION

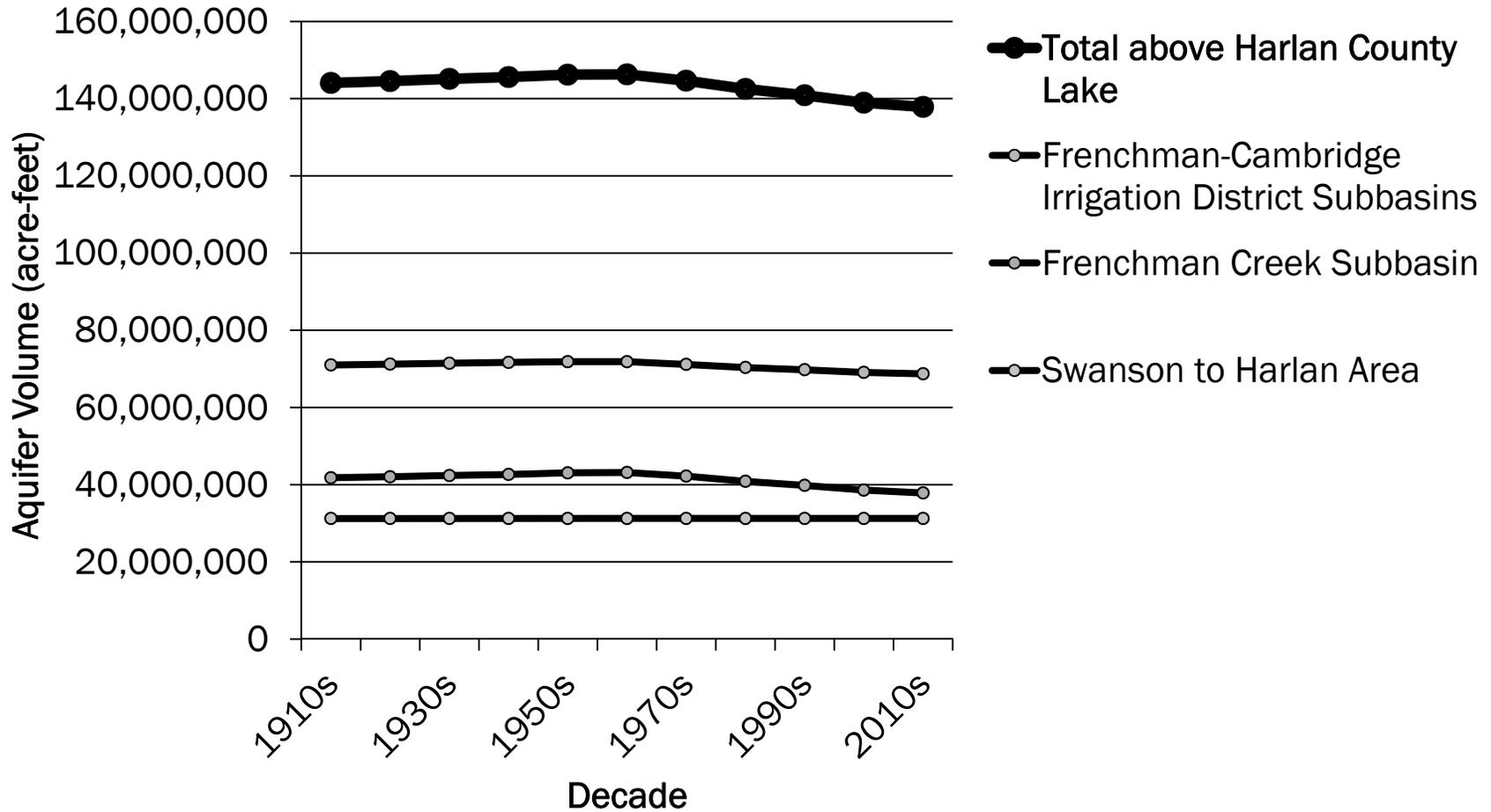
# Aquifer Volume

## by Subbasin

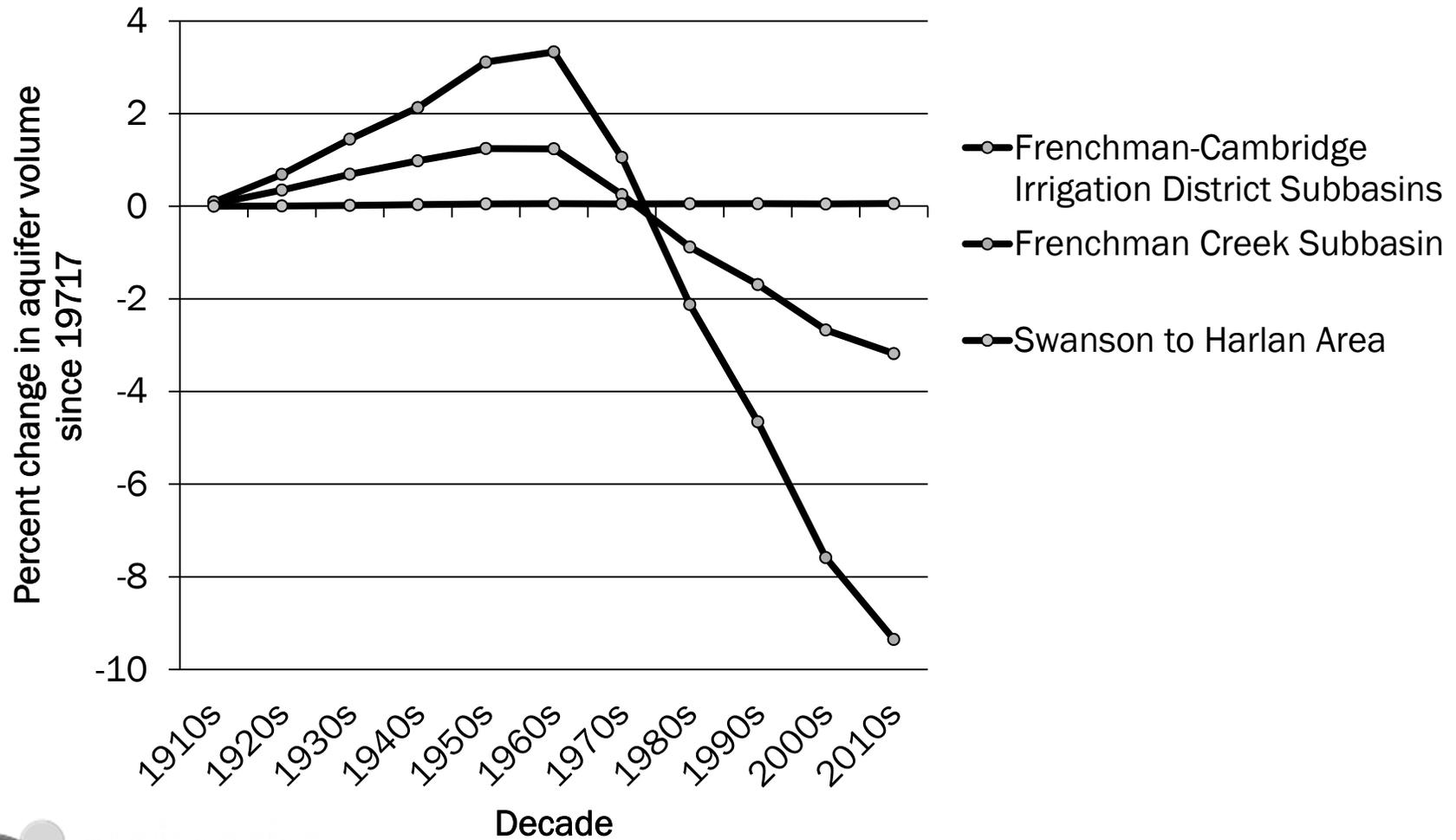


# Aquifer Volume

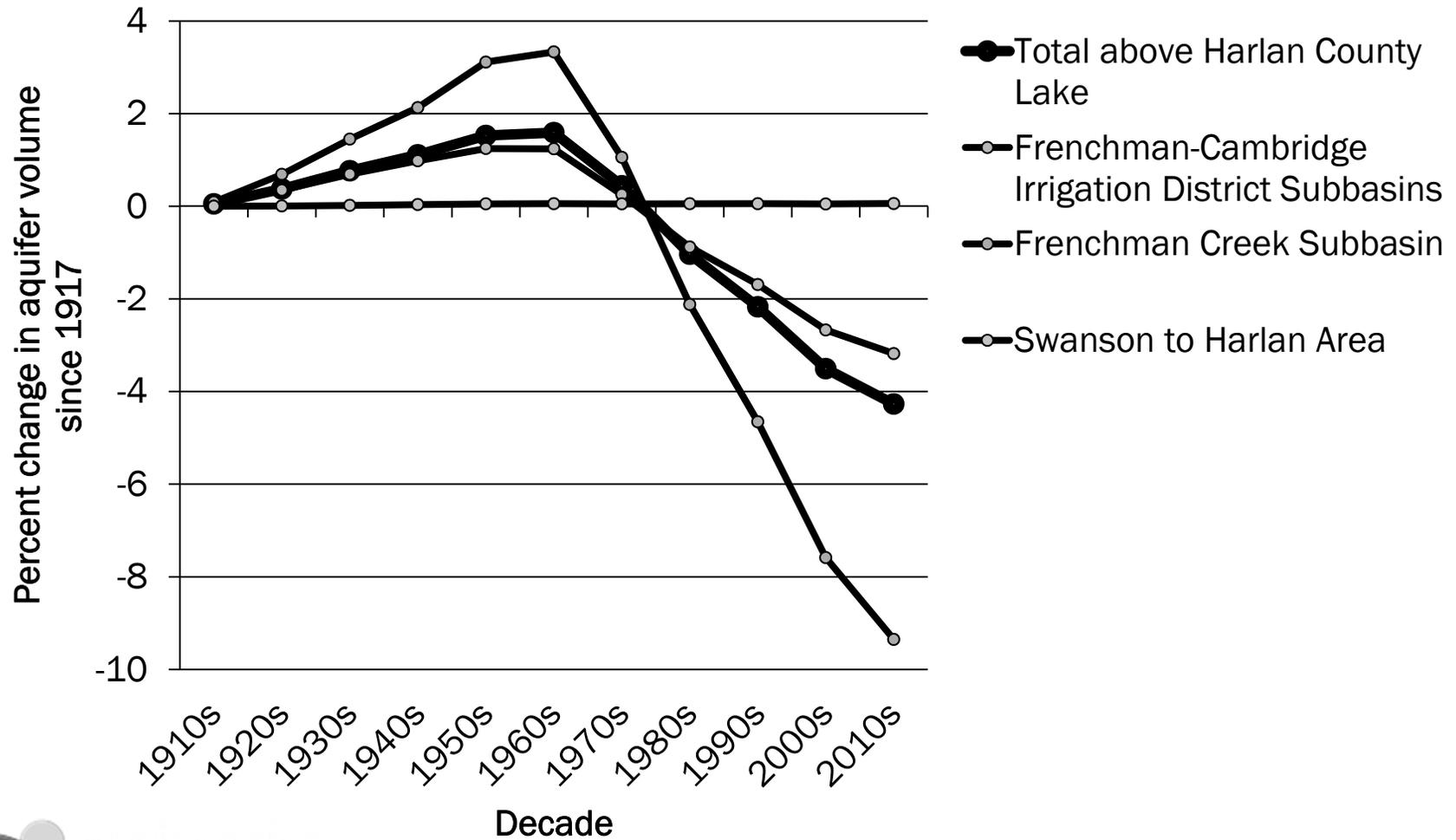
## by Subbasin



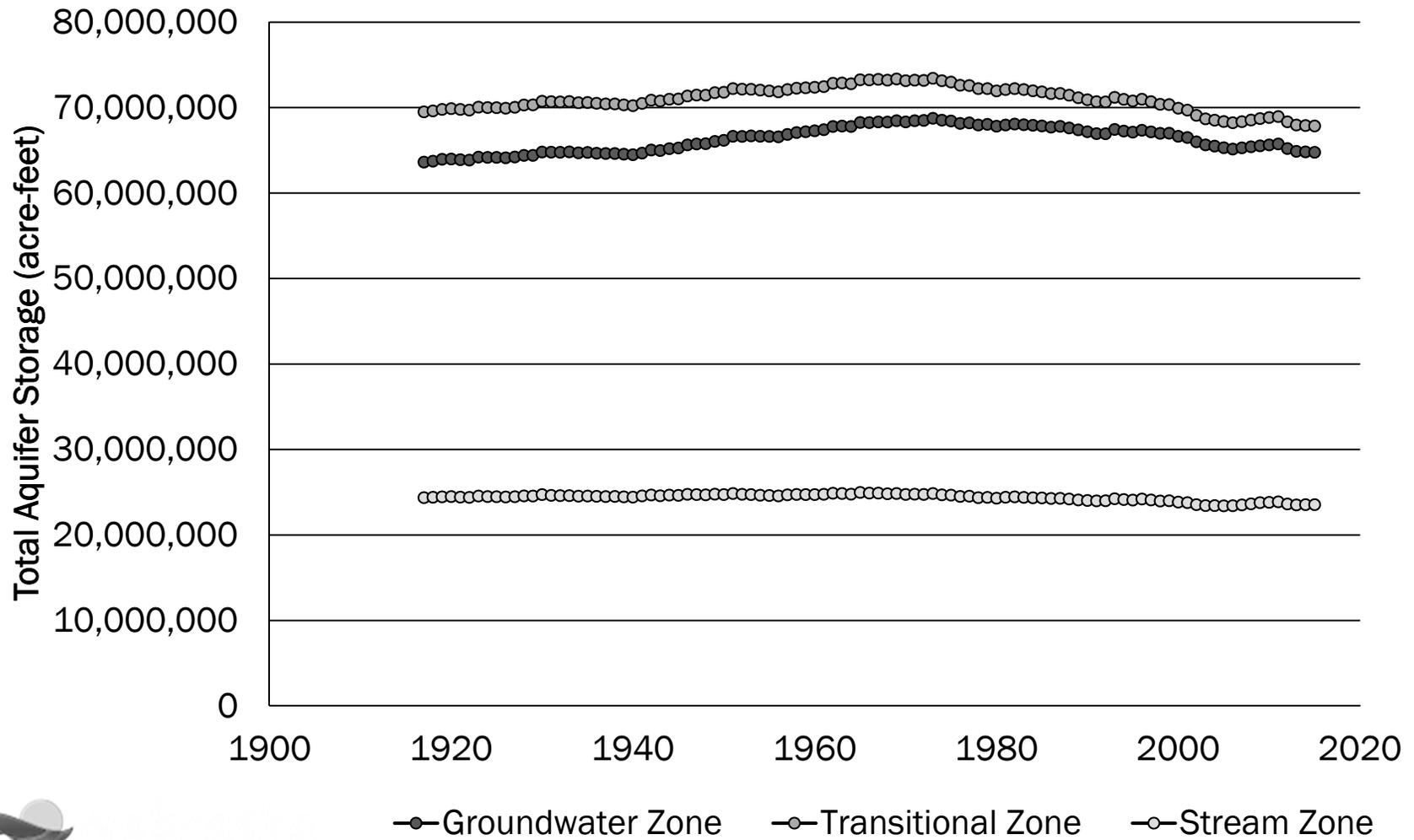
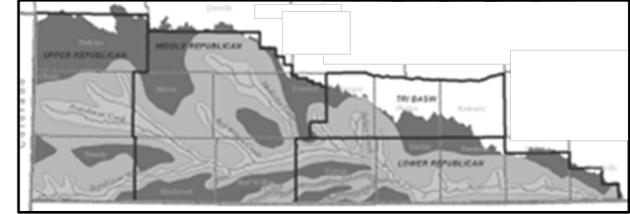
# Percent Change Since 1917 by Subbasin



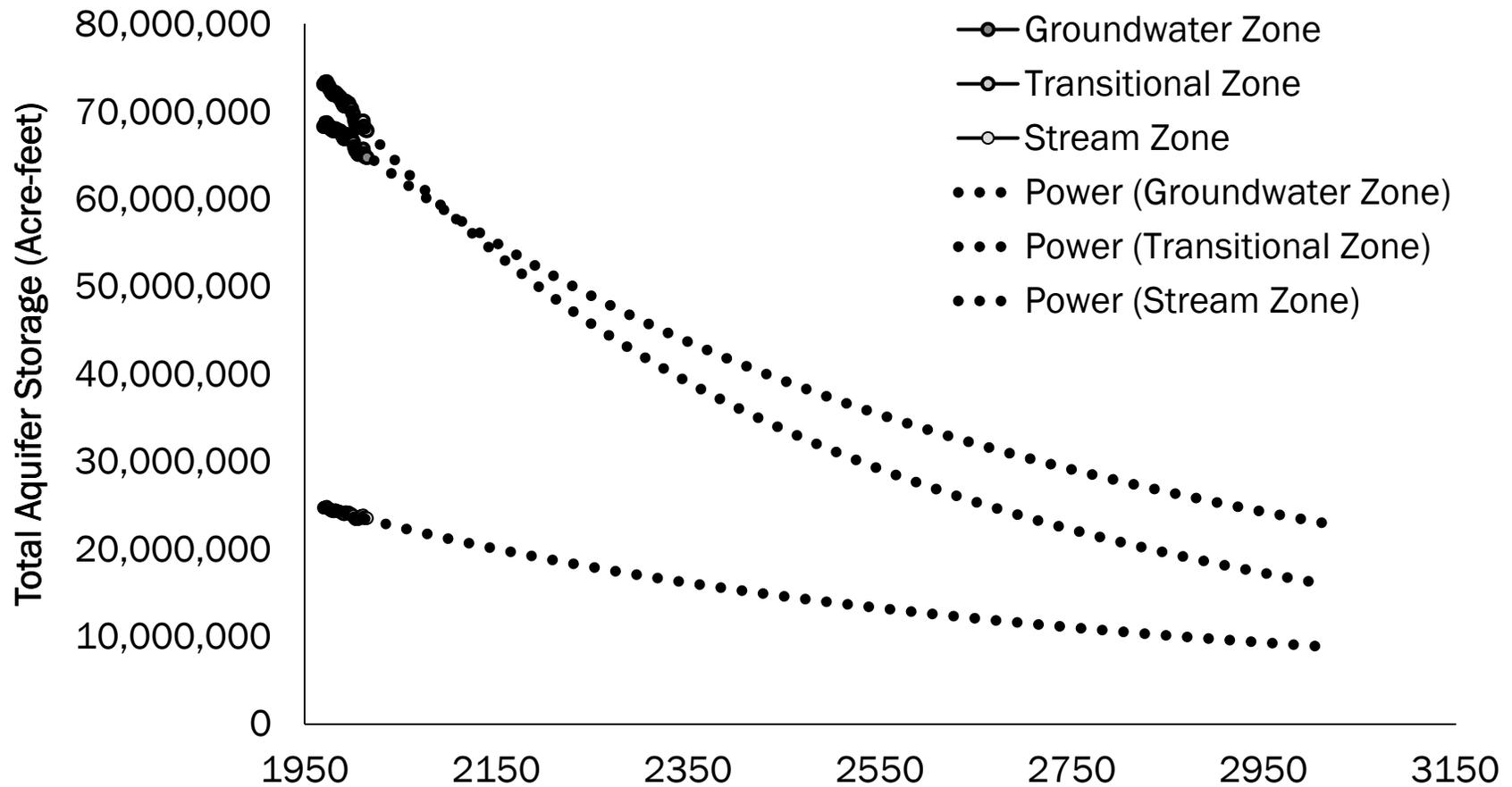
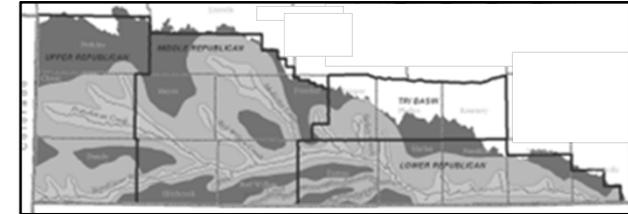
# Percent Change Since 1917 by Subbasin



# Actual Aquifer Storage by Depletion Zone



# Projection\* of Storage Reduction by Depletion Zone



\*Trends are projected 1000 years (power function) based 1970-2015 data

**Questions?**



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**THANK YOU**

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