Lake County:
Groundwaters and Inland Surface Waters

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Illinois State WATER SURVEY

ISGS Illinois State Geological Survey

ILLINOIS

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Presentation Outline

Primary focus: Water Quantity

The Hydrologic Cycle

Aquifers

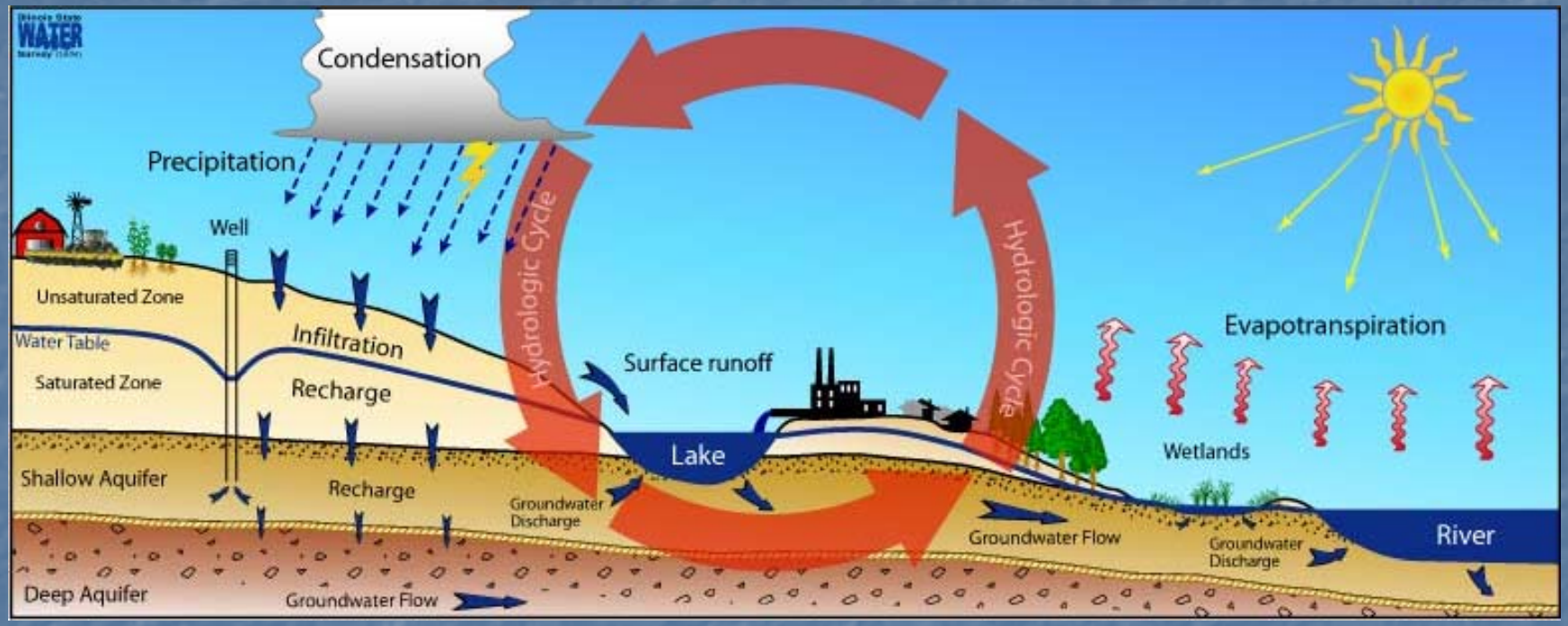
- Shallow
- Deep Bedrock

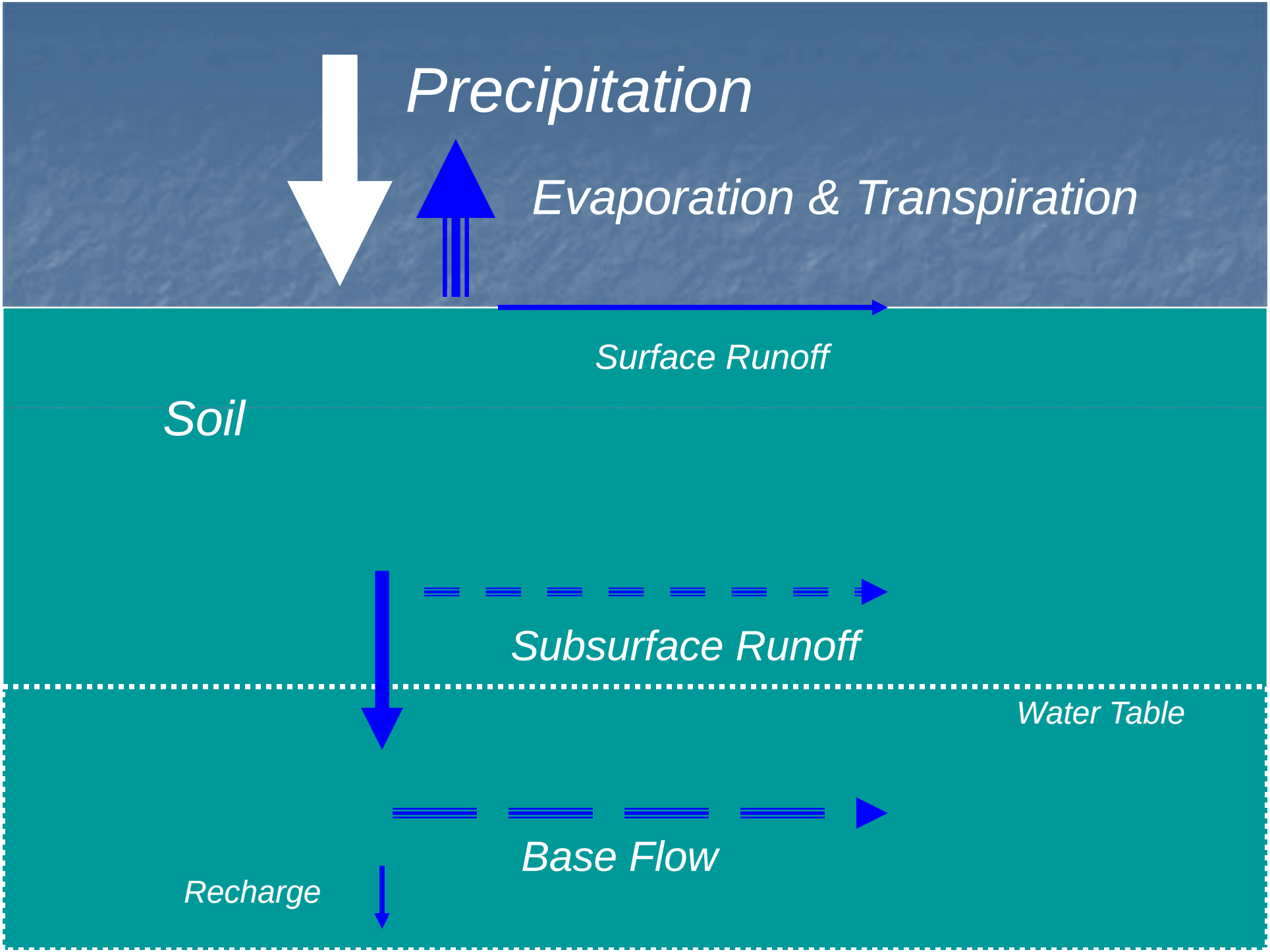
Surface Water

Climate Change

The Hydrologic Cycle

Climate, surface water, and groundwater are linked




Precipitation
Evaporation & Transpiration
Surface Runoff
Soil
Subsurface Runoff
Water Table
Base Flow
Recharge

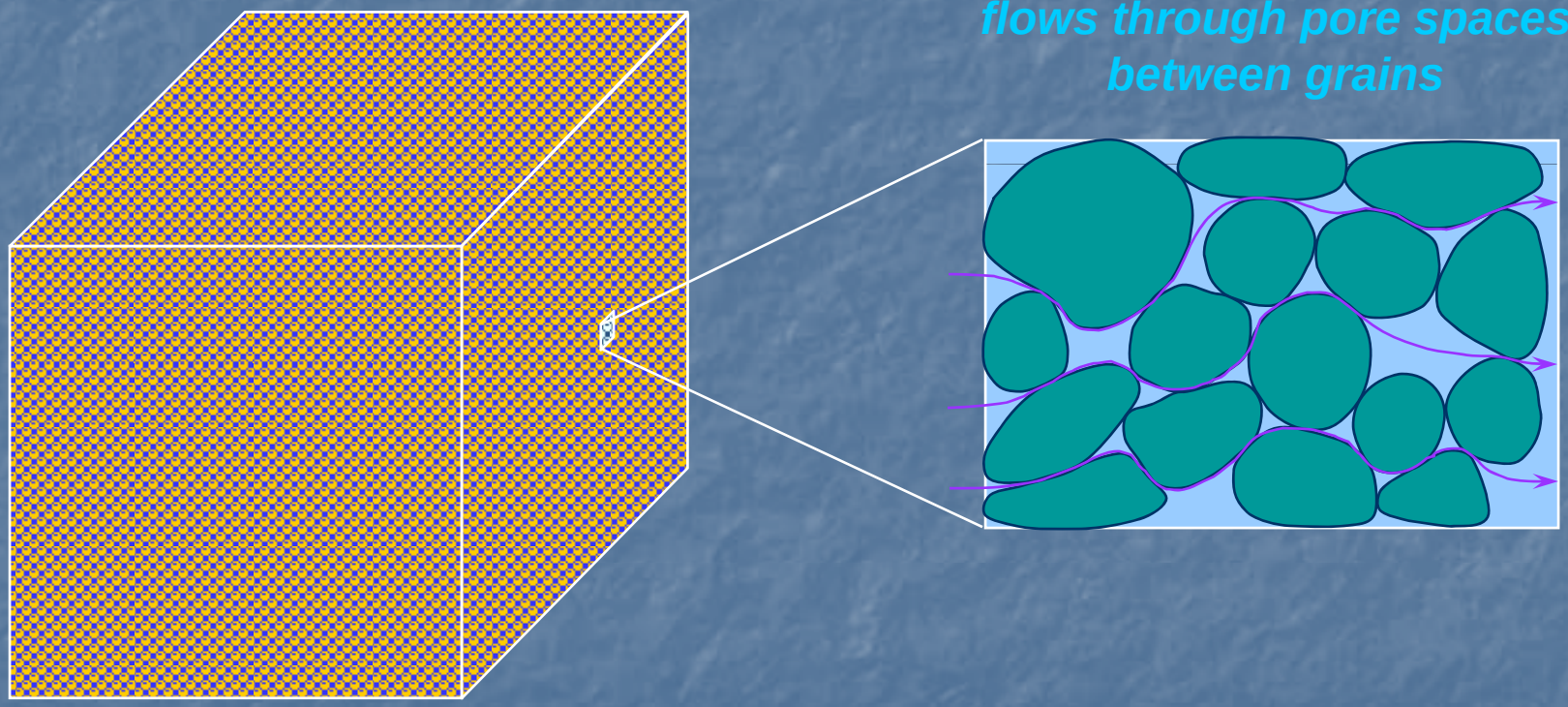
Aquifers

- What is an aquifer?
- It is not an underground:
  - river
  - stream
  - lake

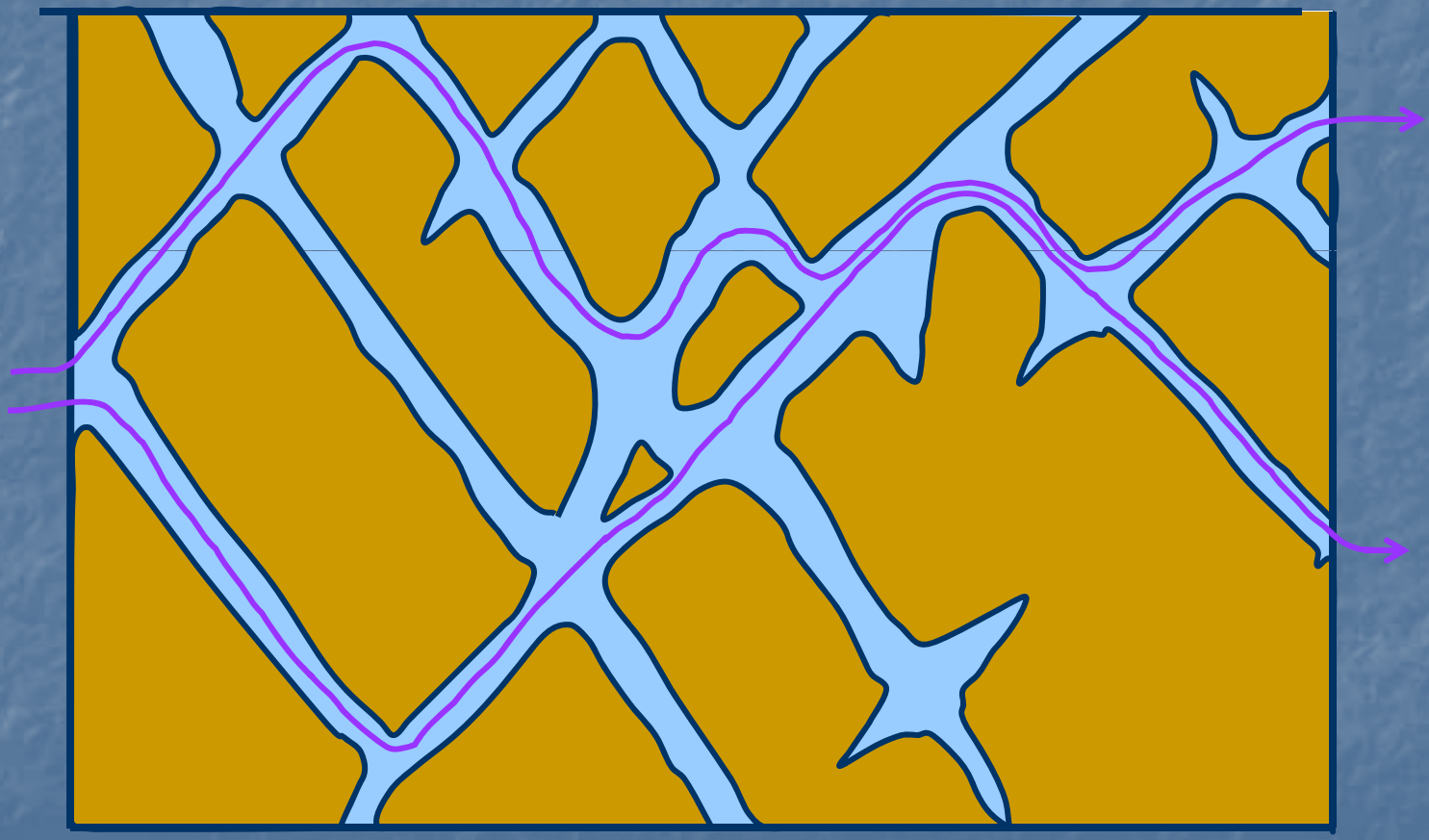
It is a water saturated geologic formation capable of yielding water.

Porous Systems

Groundwater sits in or flows through pore spaces between grains



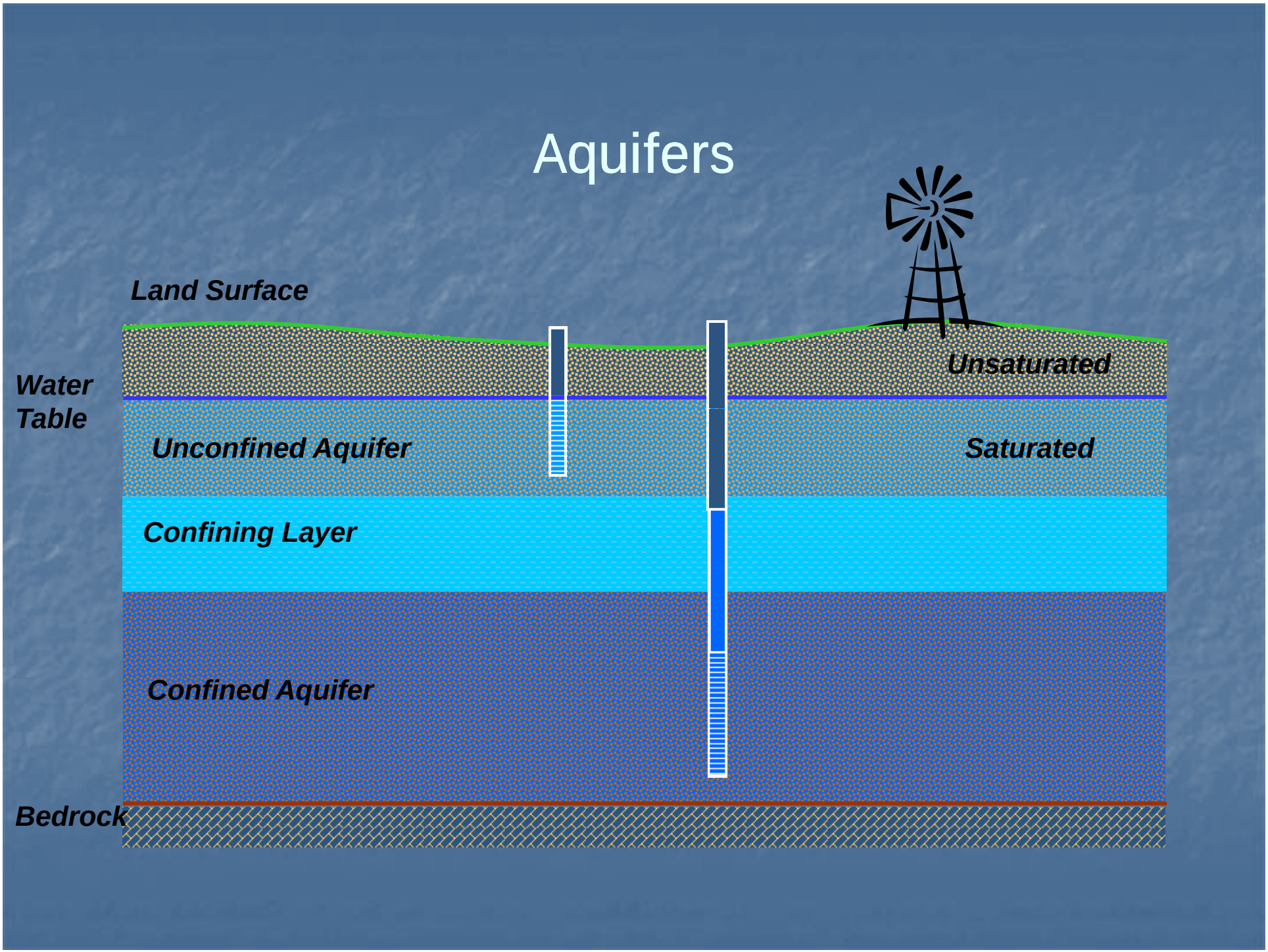
Fractured Systems



Groundwater Flow Velocities

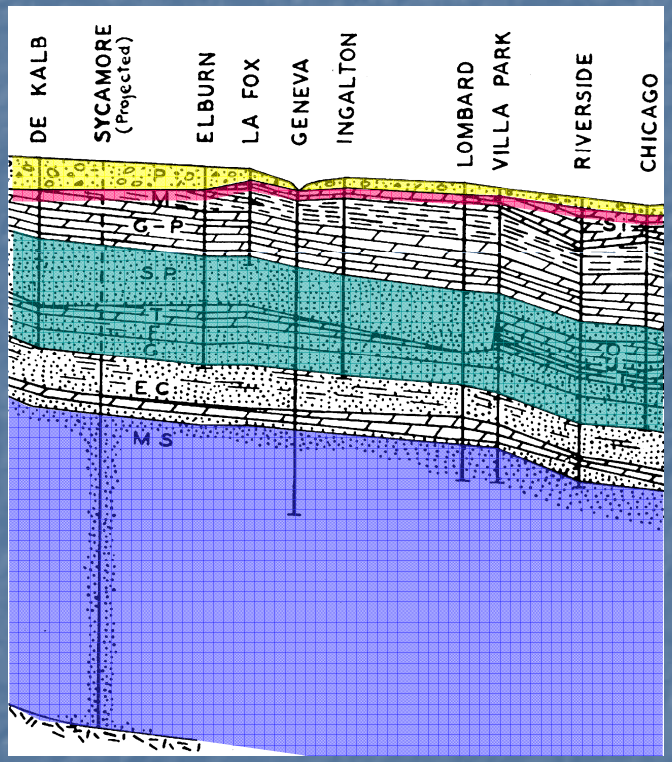
Material	Velocity
Highly fractured limestone	10-1000's feet/day
Gravel	5-10 feet per day
Clean sand	1 – 5 feet per day
Sandstone	< 0.5 feet per day

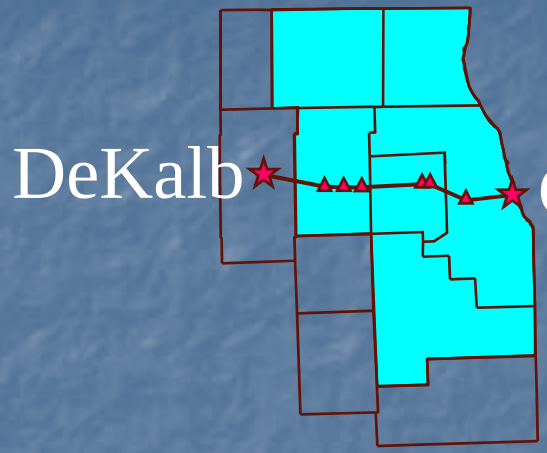
Aquifers


Land Surface
Water Table
Unsaturated
Unconfined Aquifer
Saturated
Confining Layer
Confined Aquifer
Bedrock

Aquifers of Northeastern Illinois

West East





Unconsolidated Aquifer System

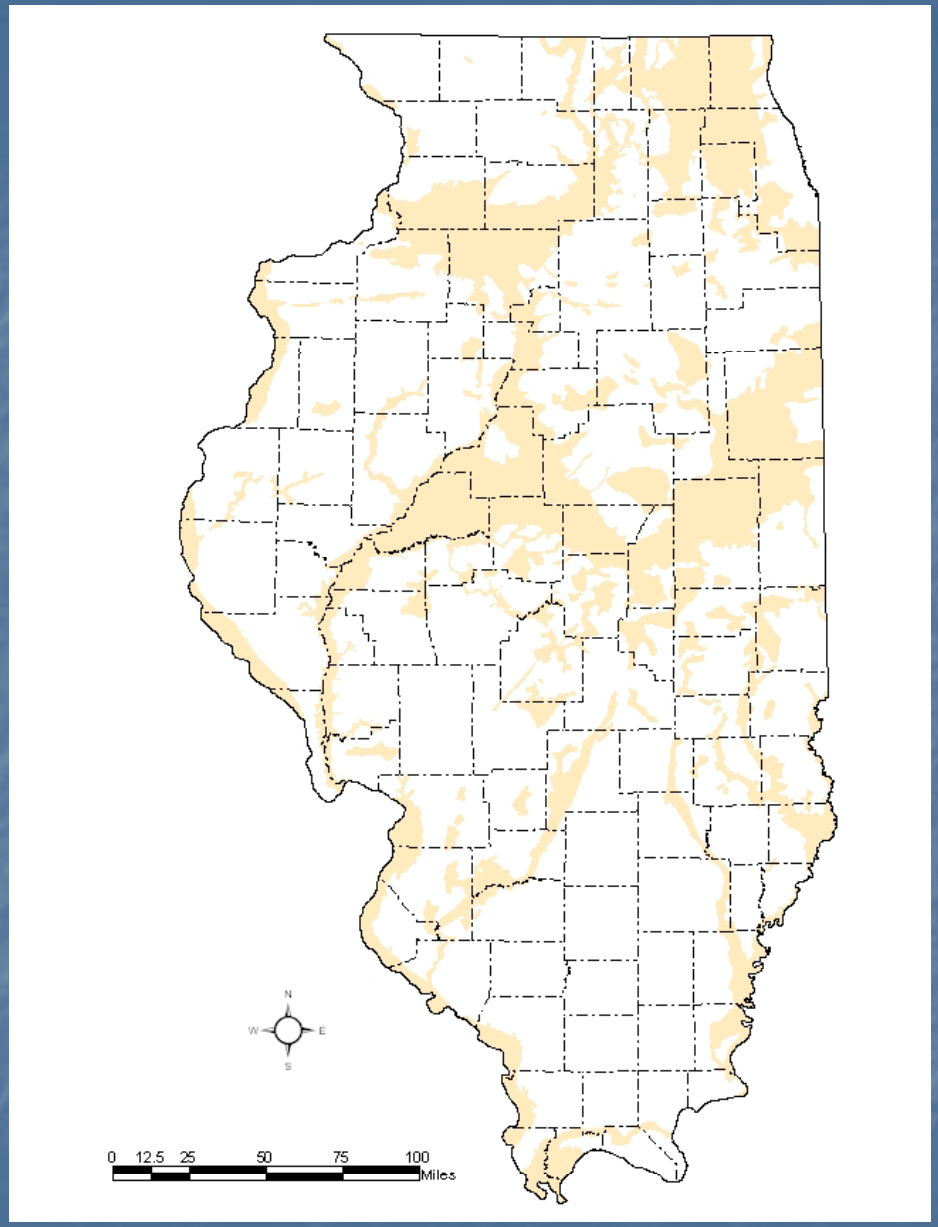
Shallow Bedrock Aquifer

Deep Bedrock Aquifer System

Elmhurst-Mt. Simon Aquifer

Cross-Section Modified from Bretz (1939)

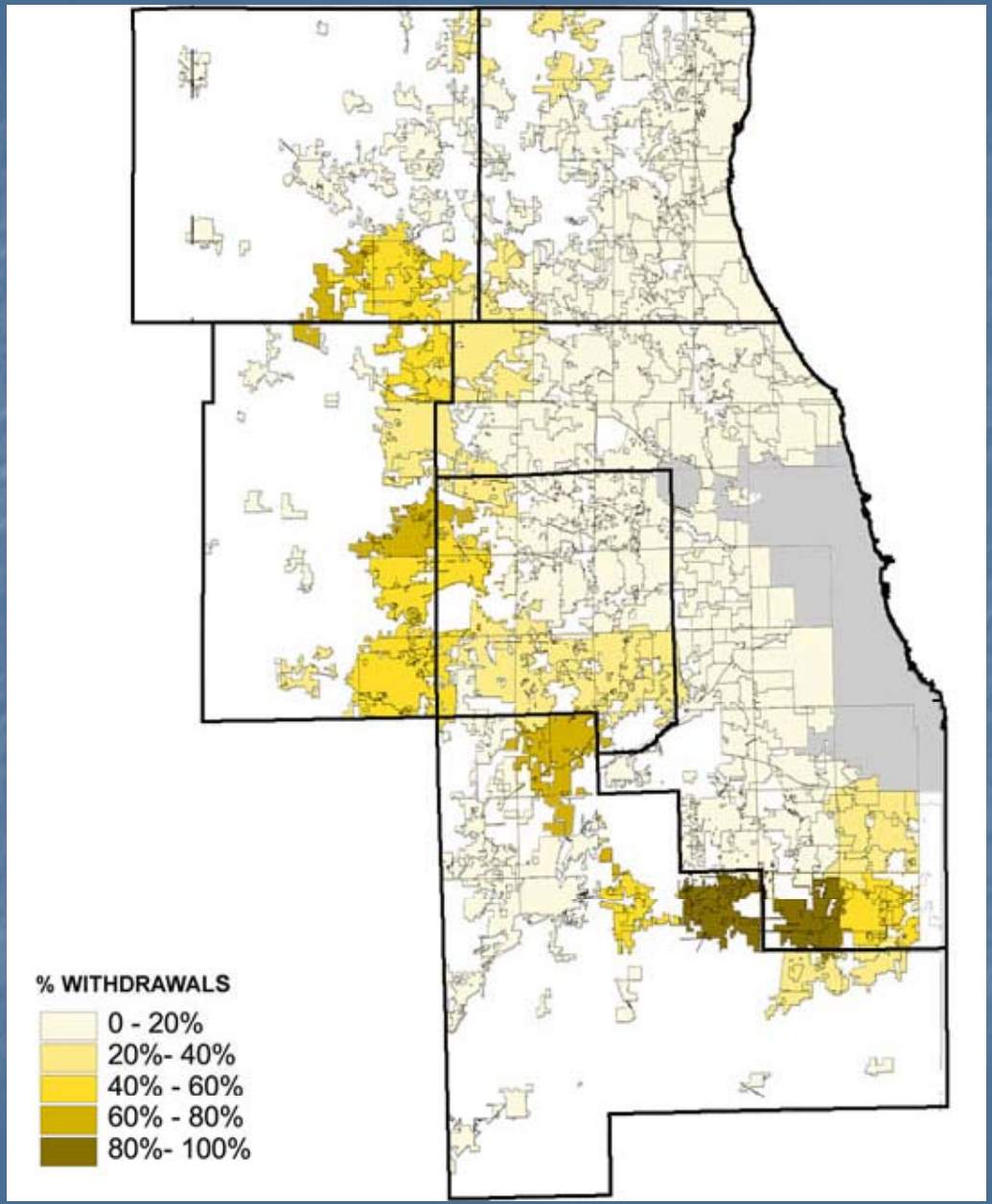
Major Sand & Gravel Aquifers



Major Shallow Bedrock Aquifers

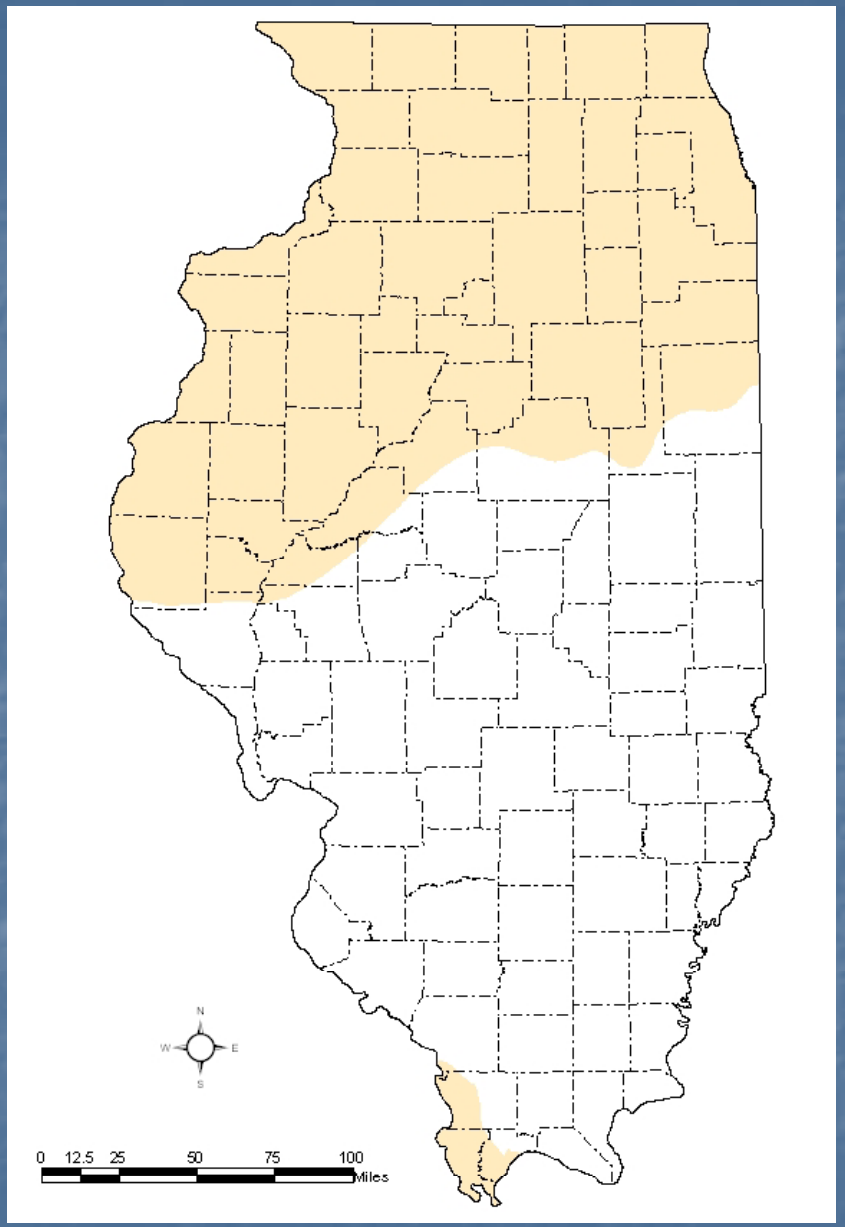
Shallow Aquifers Withdrawals in 2000

% of Estimated Yields

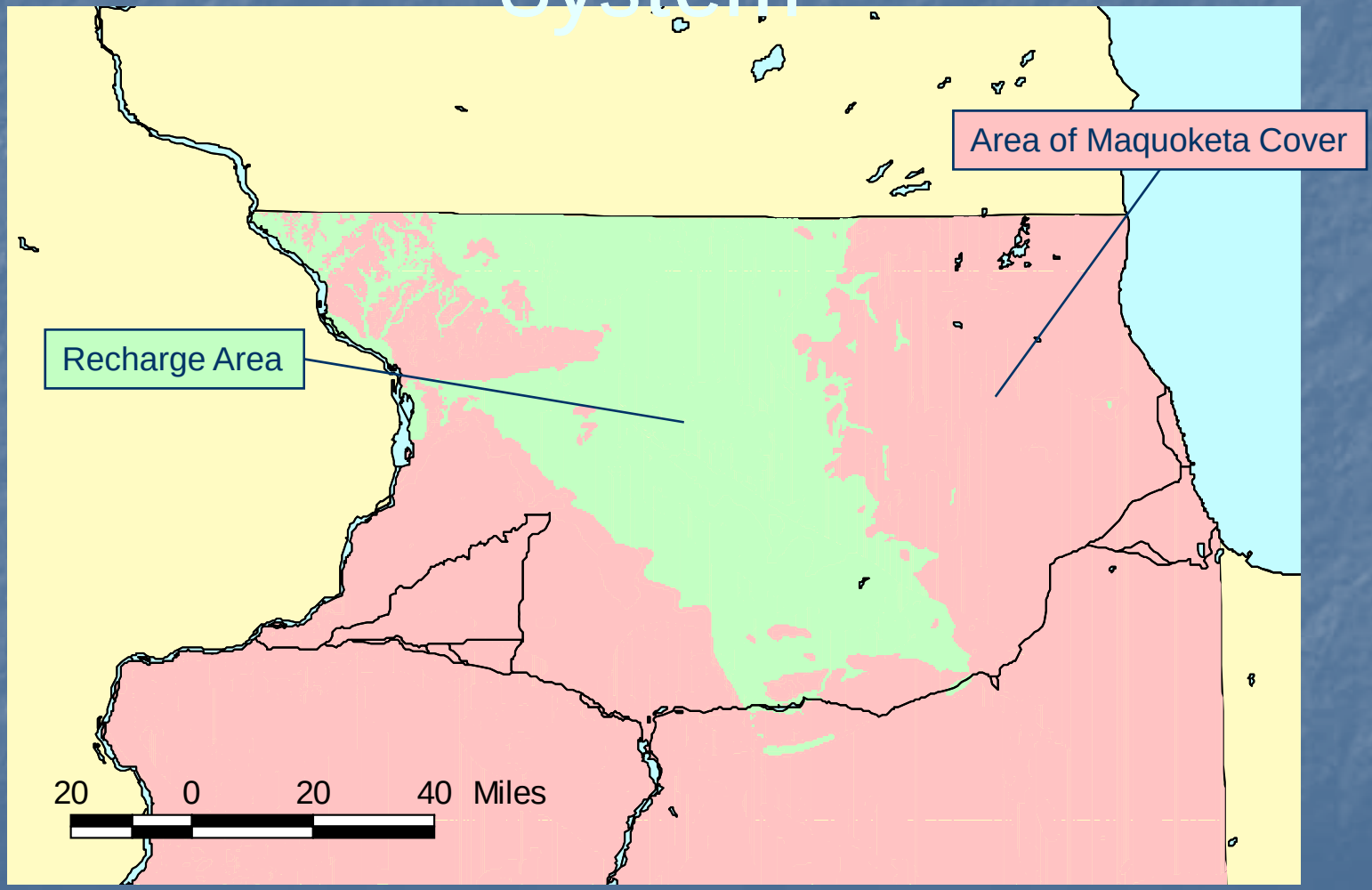


Source: ***Jaffe***

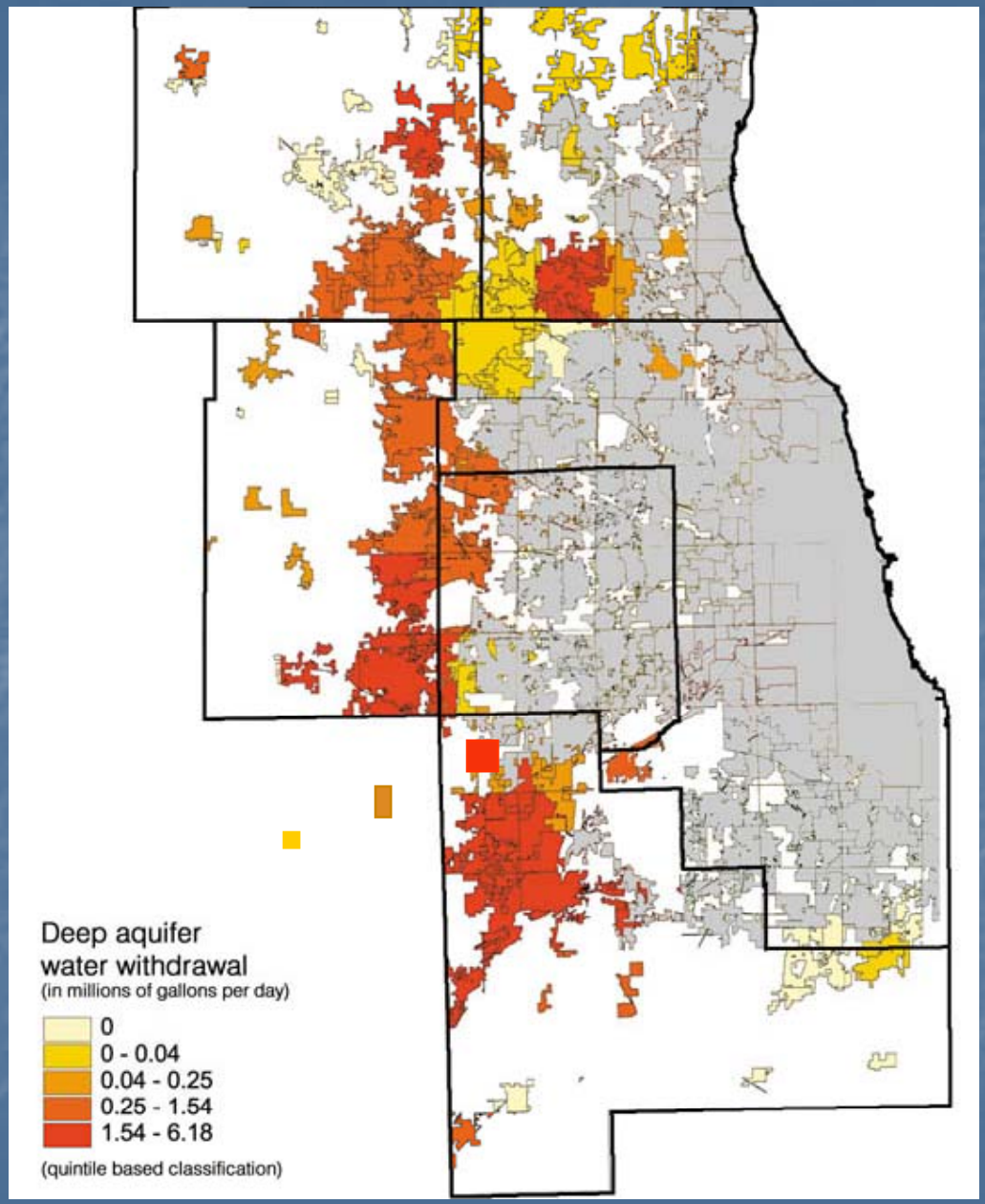
Major Deep Bedrock Aquifers



Recharge to the Deep Bedrock System

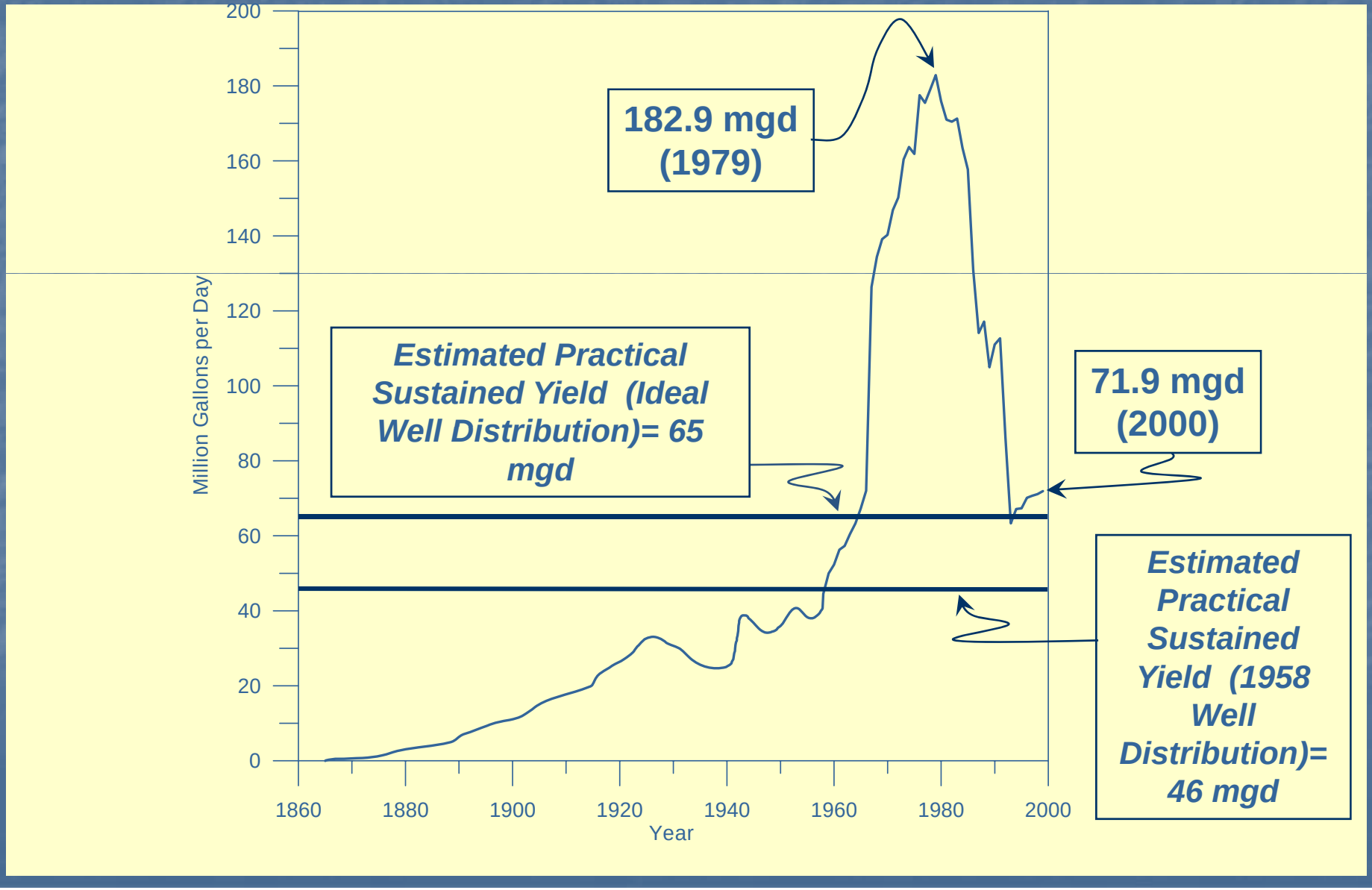


Distribution Of Deep Bedrock Aquifer Pumpage

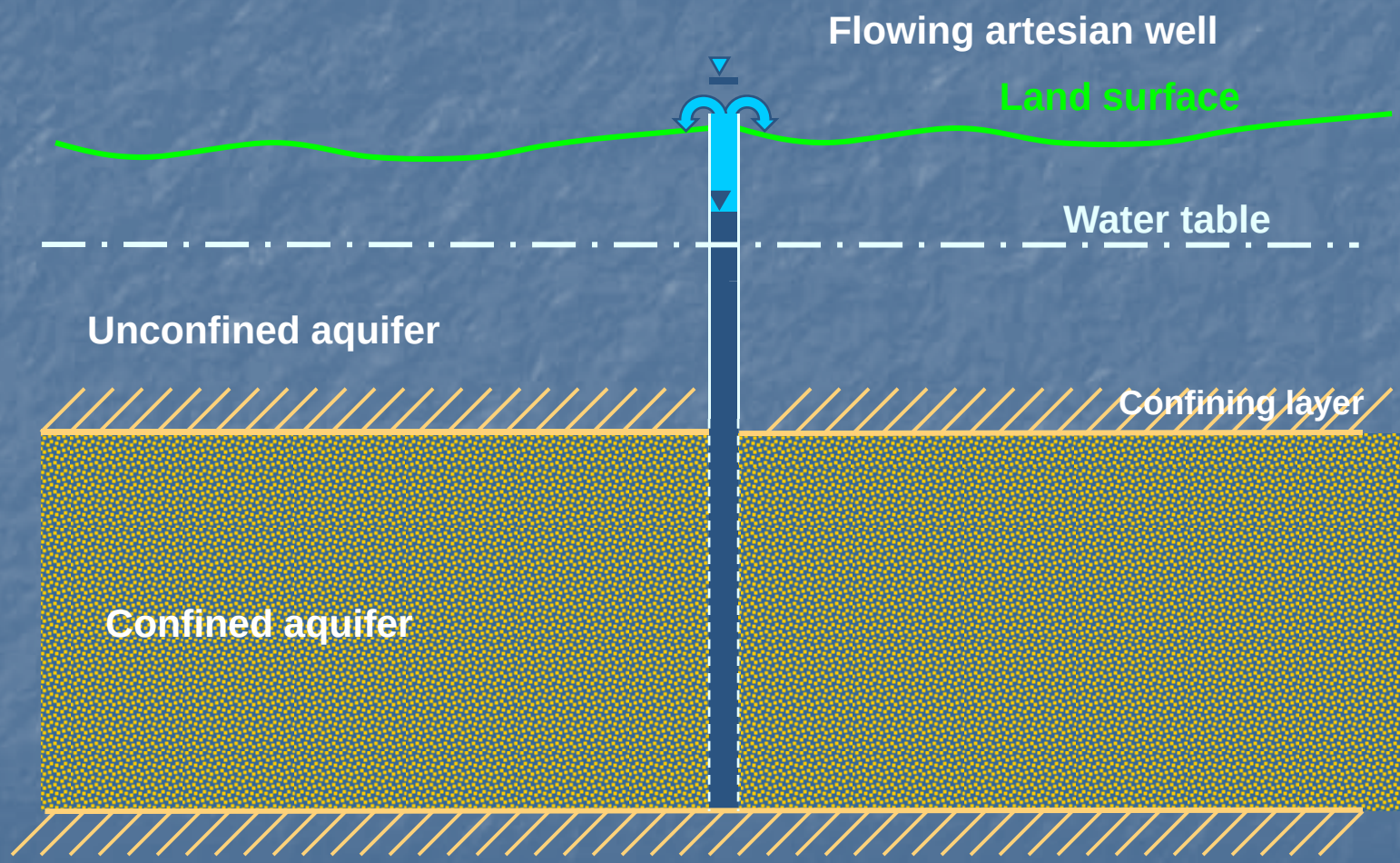


Source: Jaffe

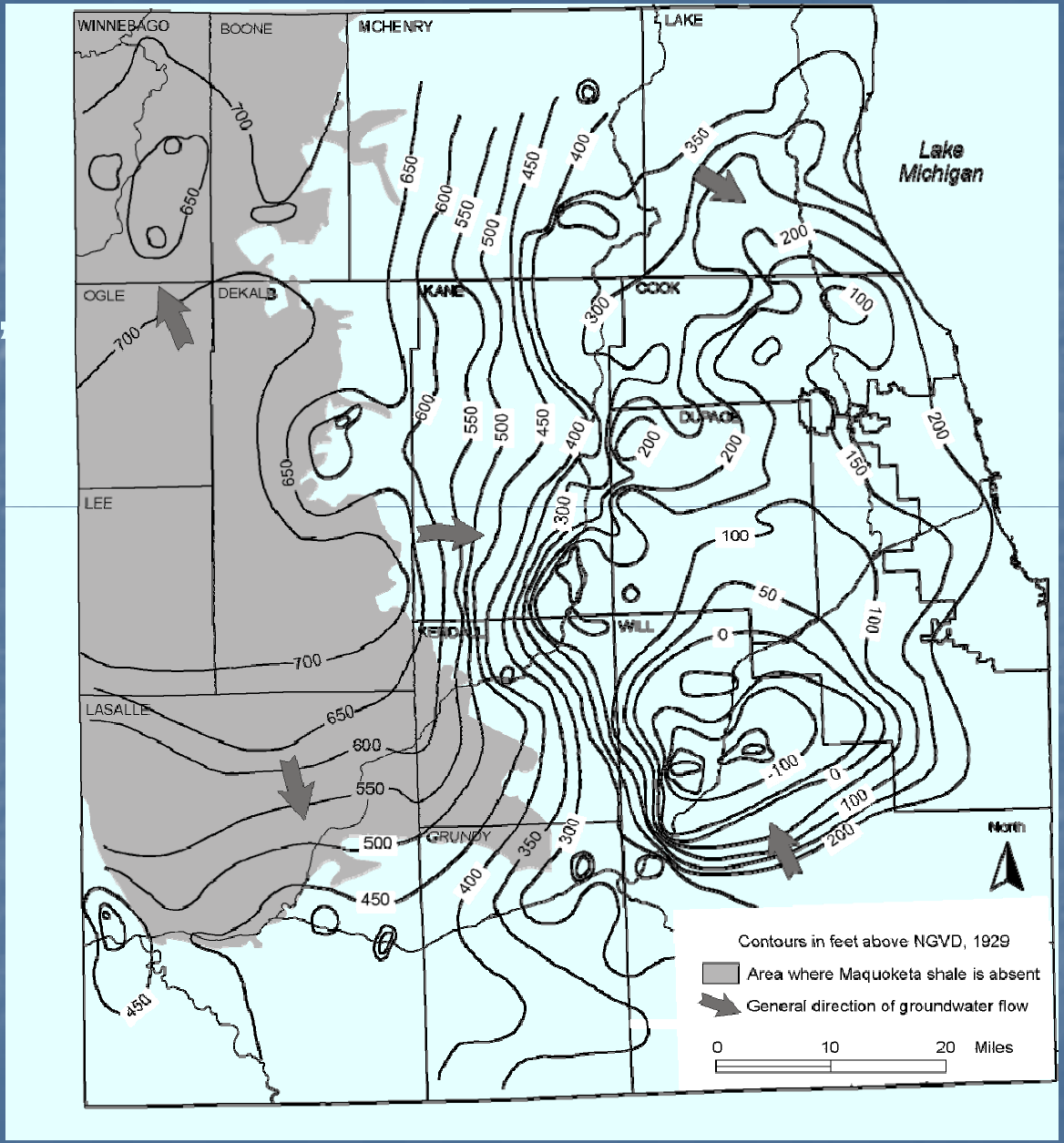
NE Illinois Deep Bedrock Withdrawals, 1900-2000



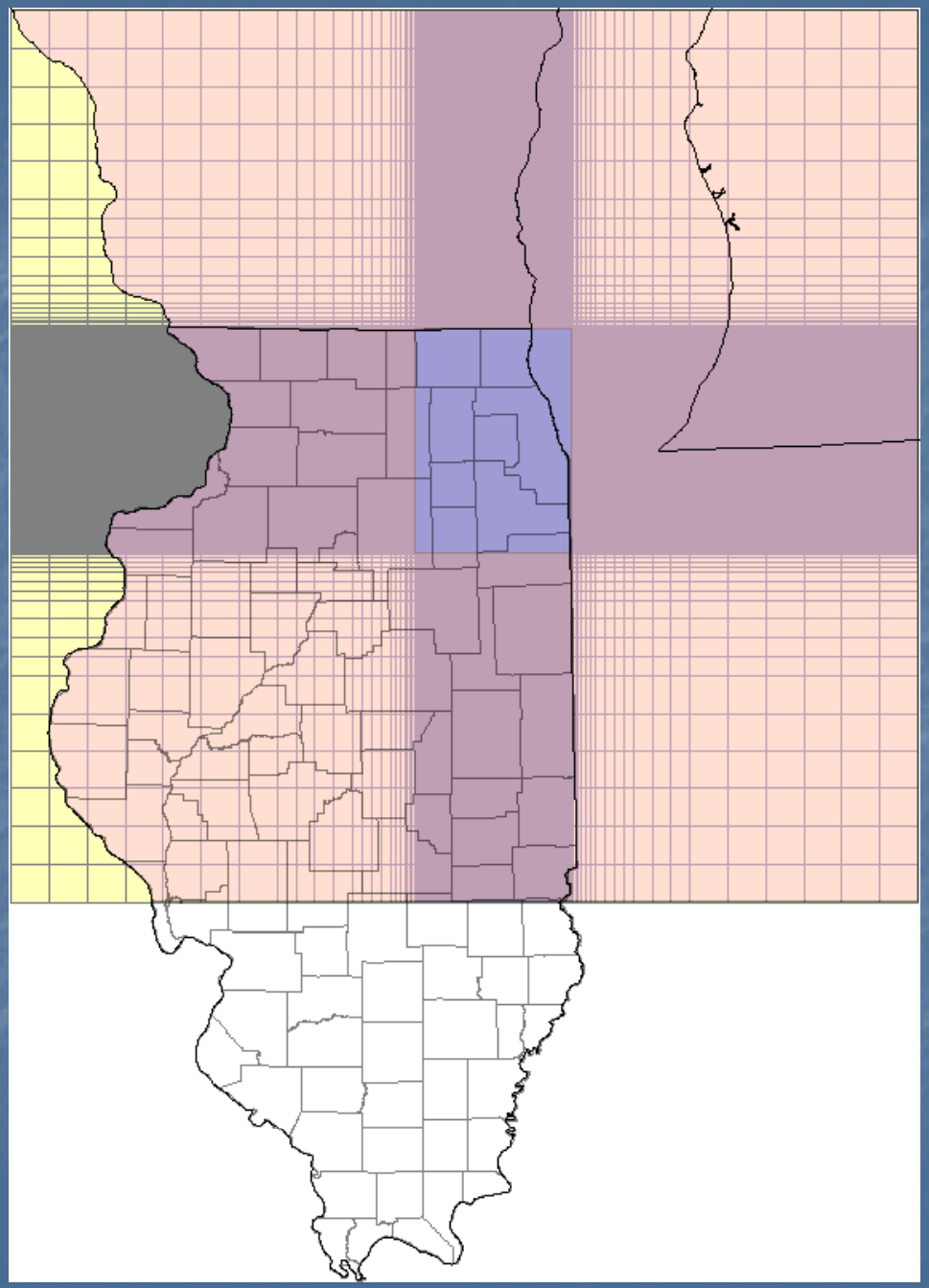
Aquifers & Artesian Wells



Potentiometric Surface of the Deep Bedrock Aquifer System, Fall 2000



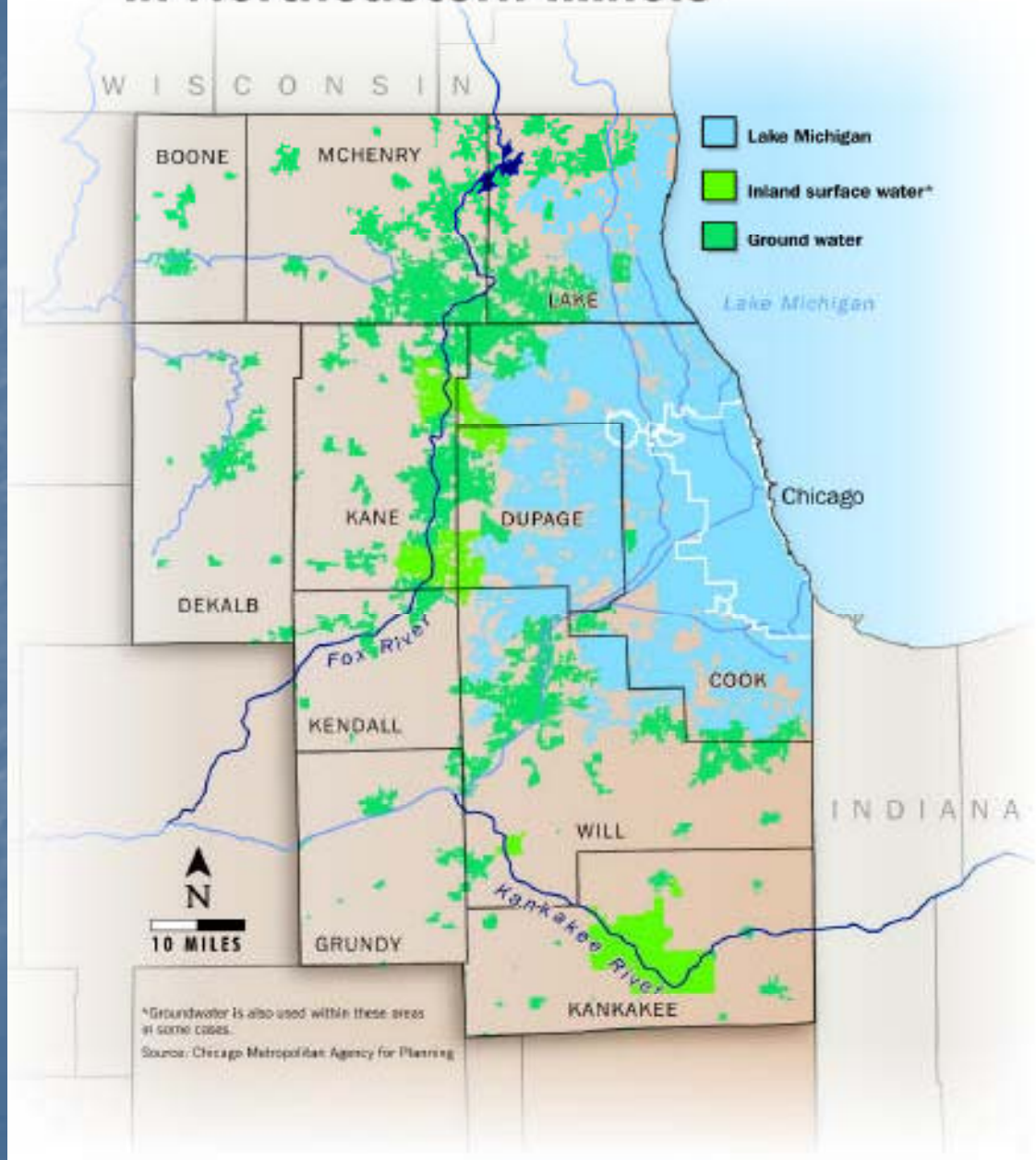
From Burch, ISWS, 2002



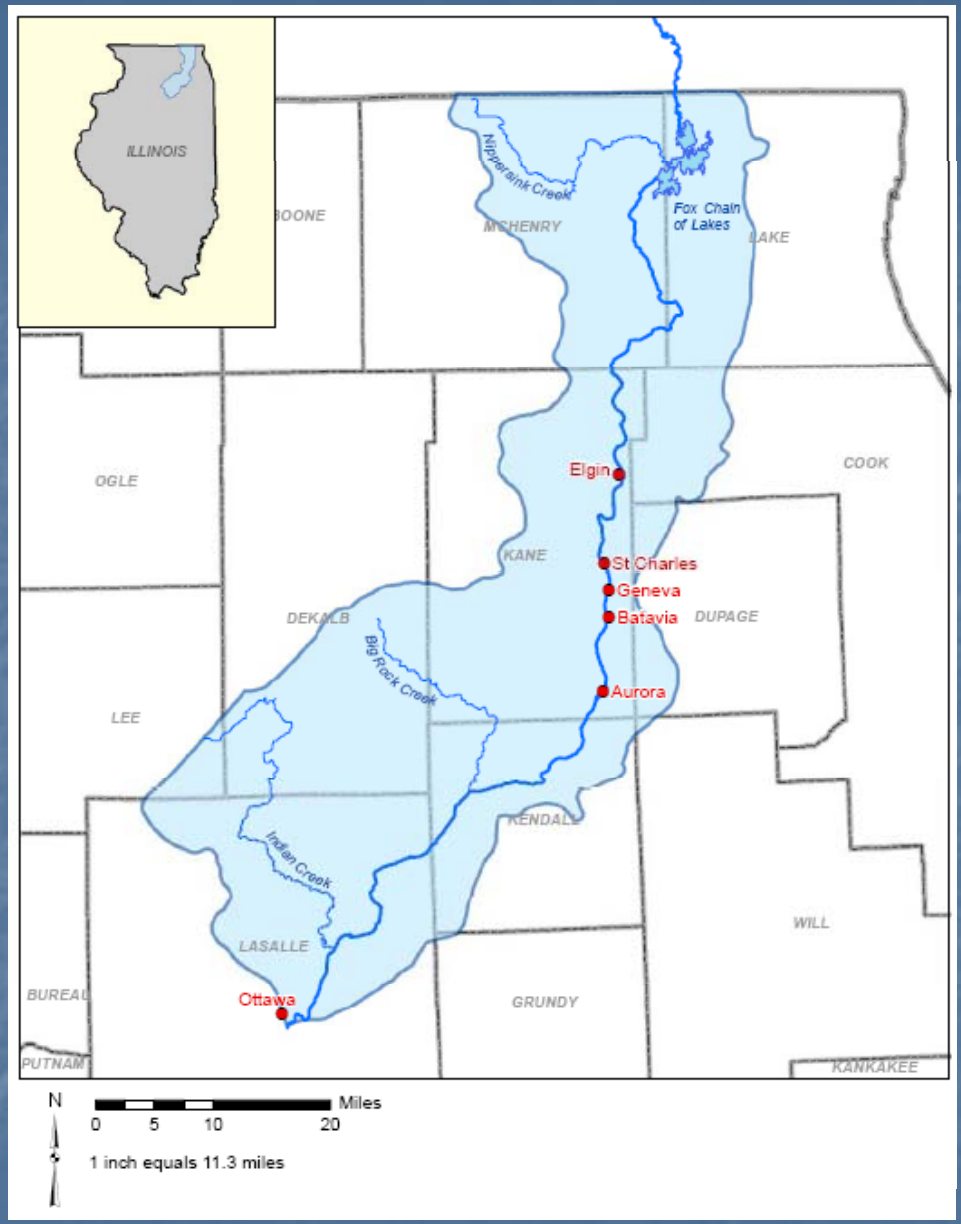
Groundwater Flow Modeling: NE Illinois Regional Model Grid

- 226 rows
- 174 columns
- 18 layers
- 707,832 nodes
- Minimum grid spacing of 2500’
- Maximum grid spacing of 80,000’

Water Sources for Public Supply in Northeastern Illinois



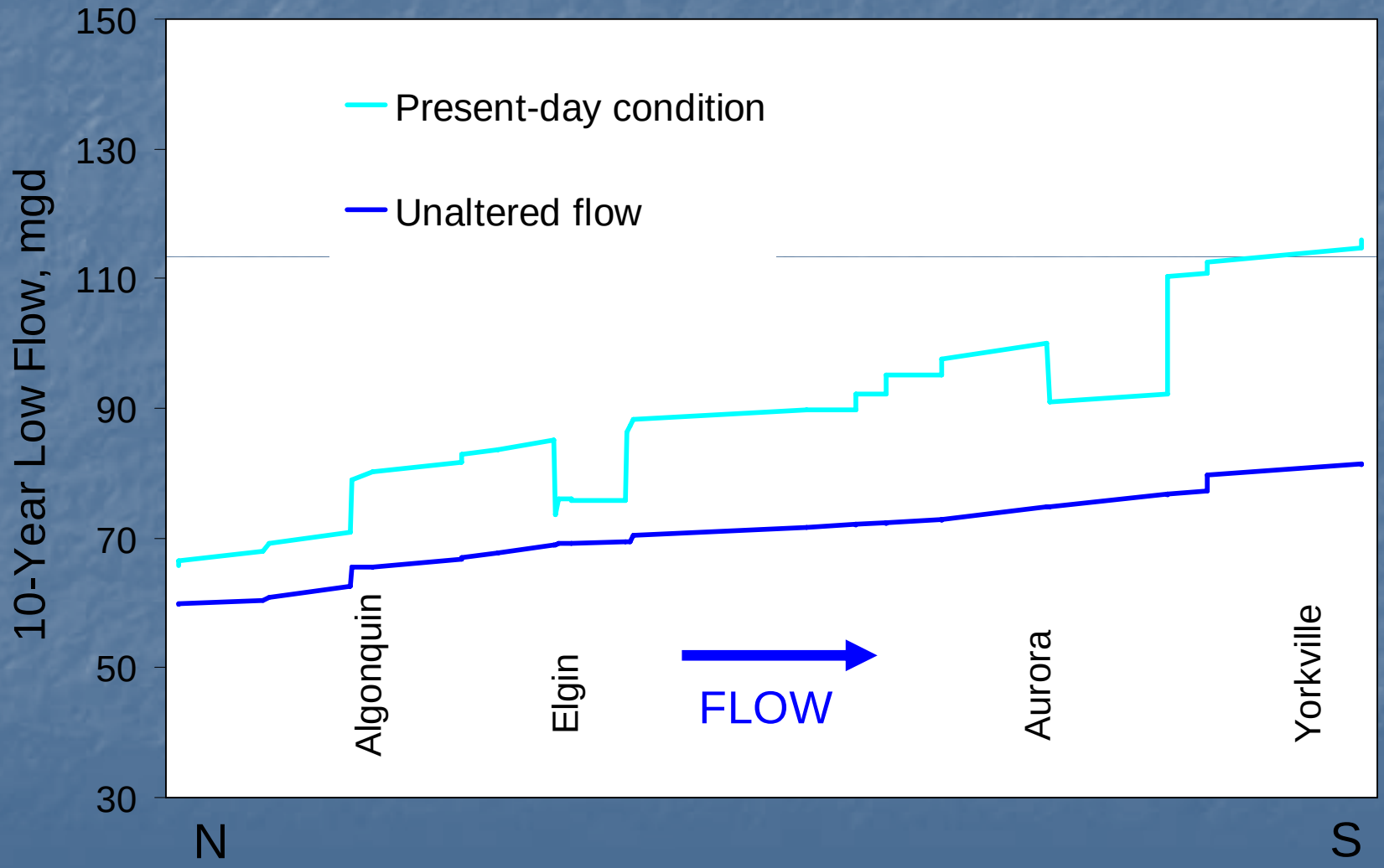
Fox River Watershed

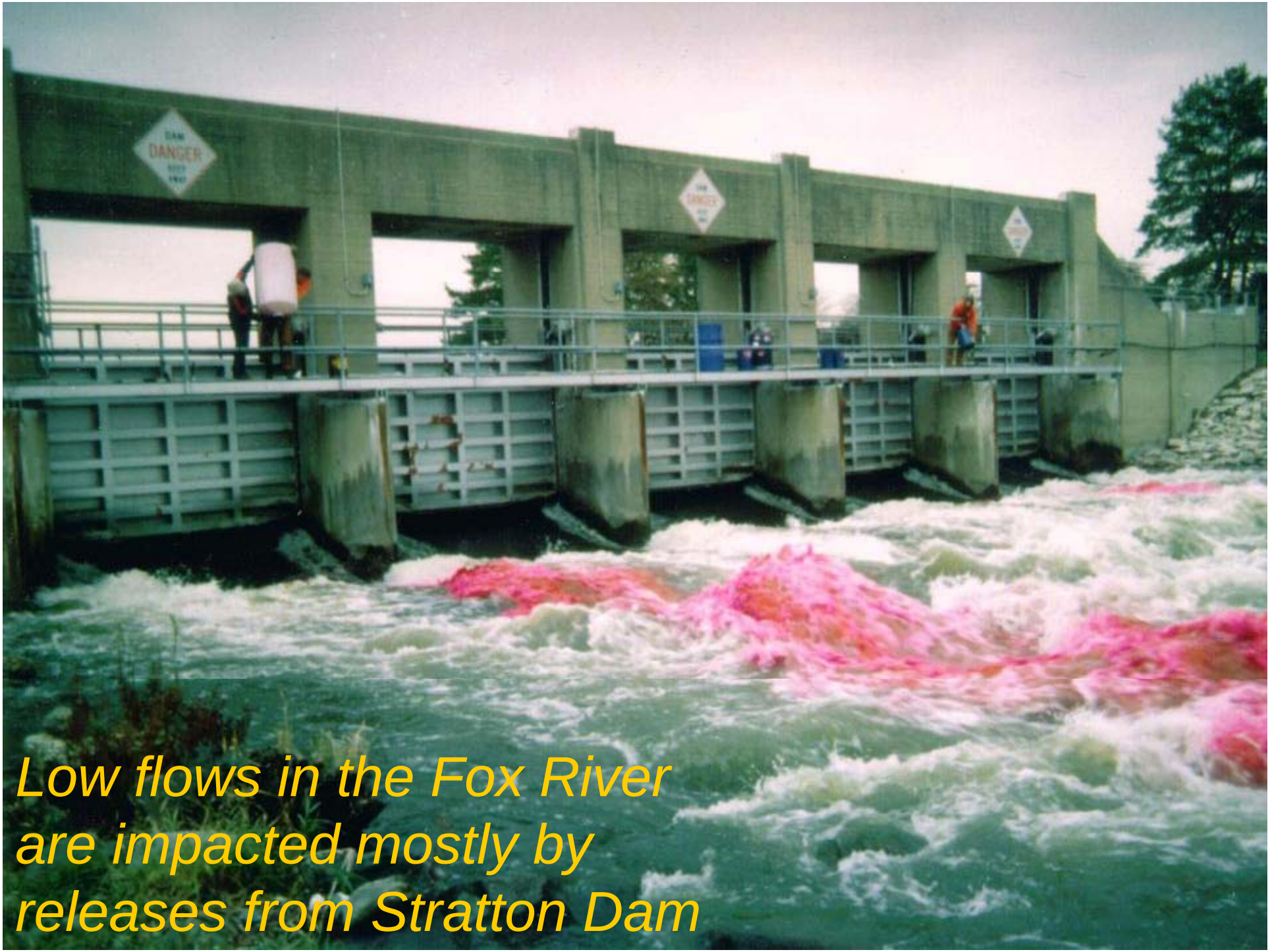


Factors affecting surface water availability

1. Climate variability & change
2. Water withdrawals & wastewater effluent
3. Reservoirs, diversions, navigation works
4. Indirect impacts on base flow (groundwater-surface interactions)
5. In-stream flow needs

10-Year Low Flows along the Fox River

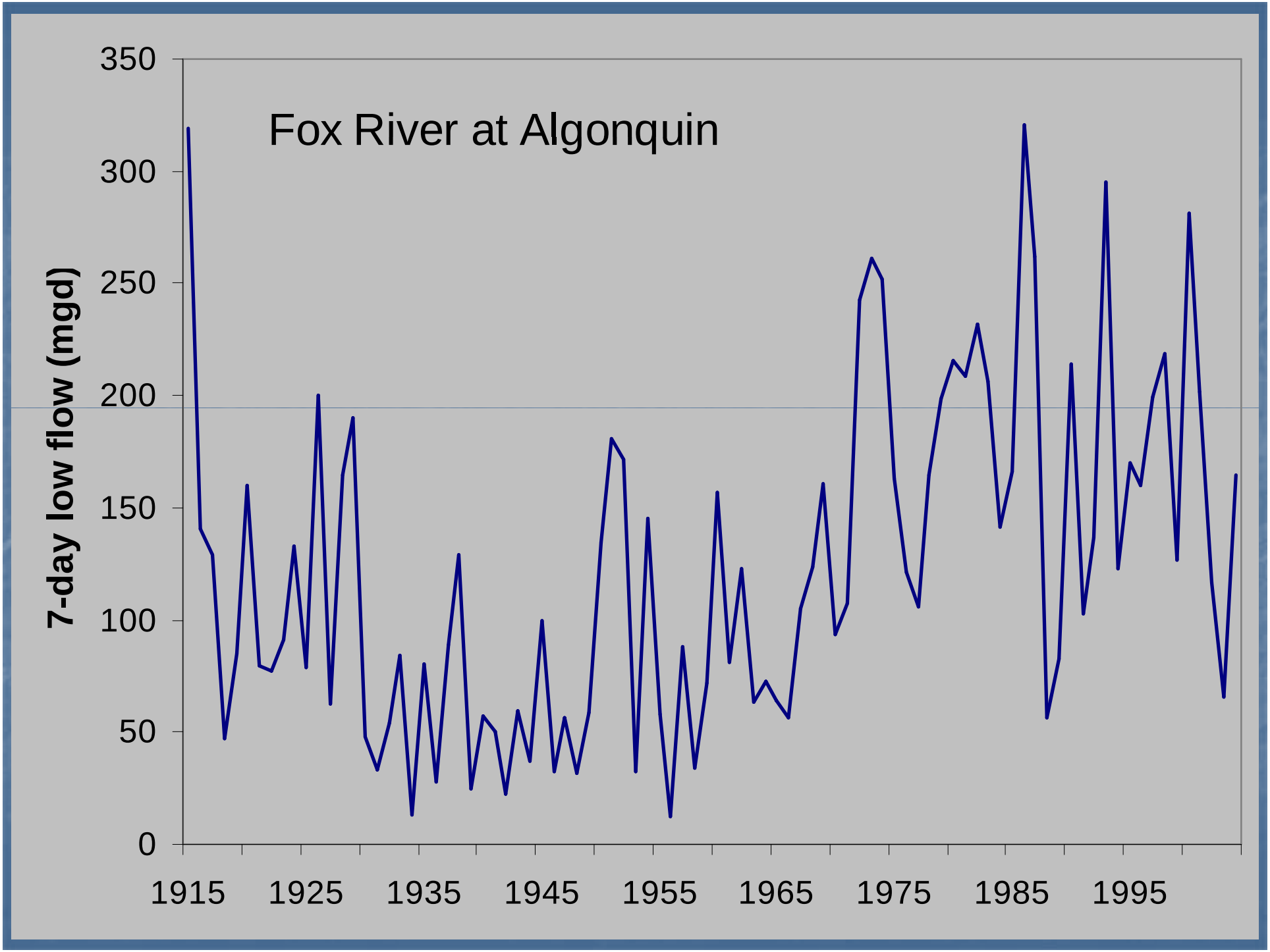




Low flows in the Fox River are impacted mostly by releases from Stratton Dam

Flows from Stratton Dam

- Flow into the Chain of Lakes has been augmented by wastewater effluents, most coming from the Waukesha, WI area.
- A minimum gate opening, releasing 57 mgd was established in 1988.
- Raising the summer pool elevation since 1965 has greatly reduced the frequency of low flows occurring downstream.


Fox River at Algonquin
7-day low flow (mgd)
350
300
250
200
150
100
50
0
1915
1925
1935
1945
1955
1965
1975
1985
1995

Instream Flow Needs

- Aquatic habitat / biological health
- Assimilation of waste waters (dilution)
- Recreation/Aesthetics

Instream flow needs can be in conflict with one another.

Surface Water Accounting Tool for the Fox River Basin

- Evaluate flow quantity
- Examine impacts of future water use scenarios on streamflows.
- Future application: evaluate impacts from climate change scenarios and surface–groundwater interaction as they become better understood.

Fox River Issues

- Wastewater discharges will increase substantially as water use in the watershed increases, increasing flow.
- Assimilation of wastewaters and improving wastewater treatment technology will likely define to what degree the Fox River can be a source for additional water withdrawals.
- Increased use of shallow groundwater may reduce flow, particularly in tributaries, due to groundwater-surface water interaction.

CLIMATE

- CLIMATE CONDITIONS ARE A MAJOR FACTOR IN WATER SUPPLY

DEFINITION of CLIMATE

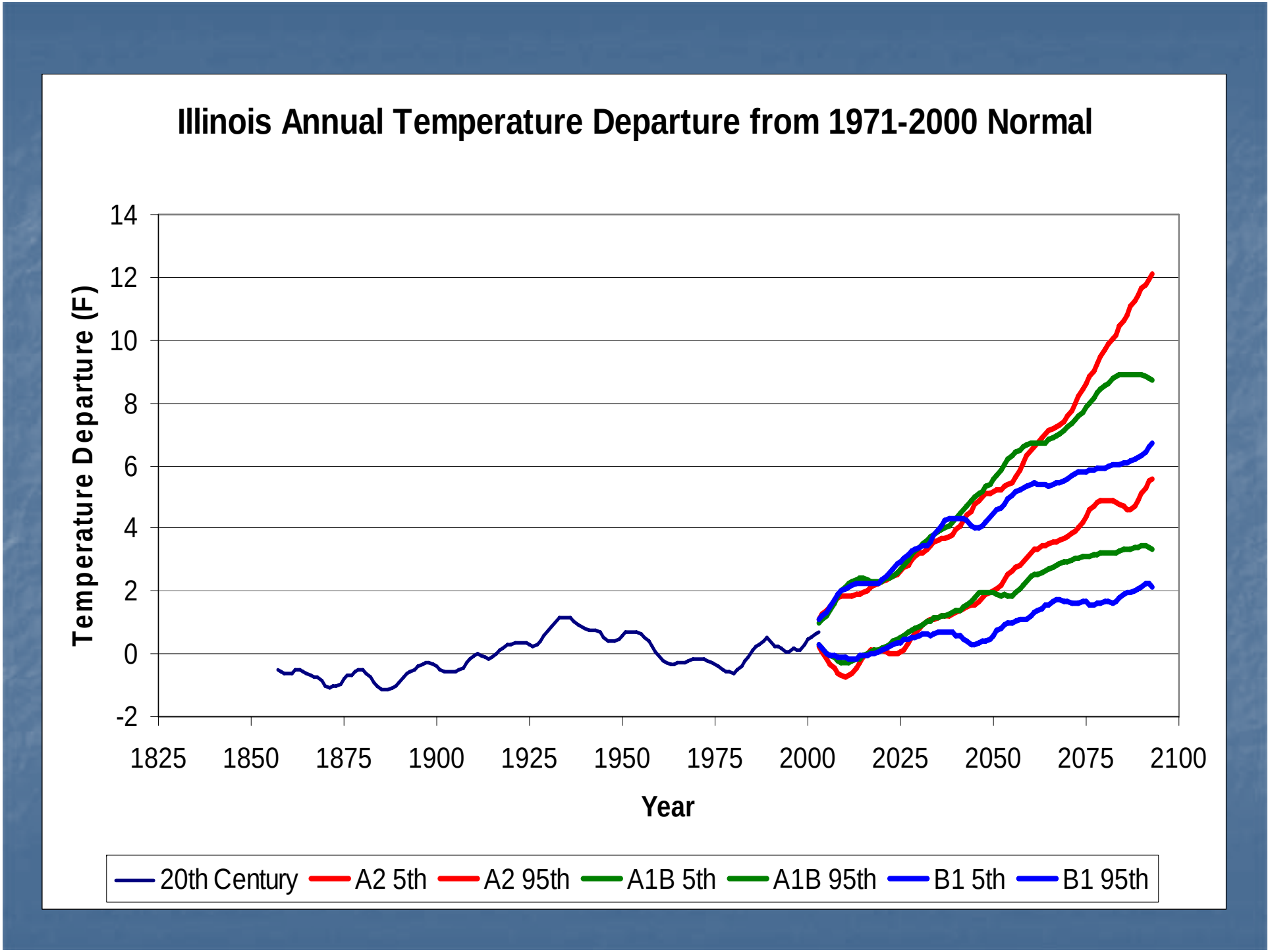
- The statistical aggregate of weather conditions over a period of time.
- “Normal” Climate is set over 30 year periods.
- Current “normal” period is 1971-2000.
- This will change to 1981-2010 in 2011.

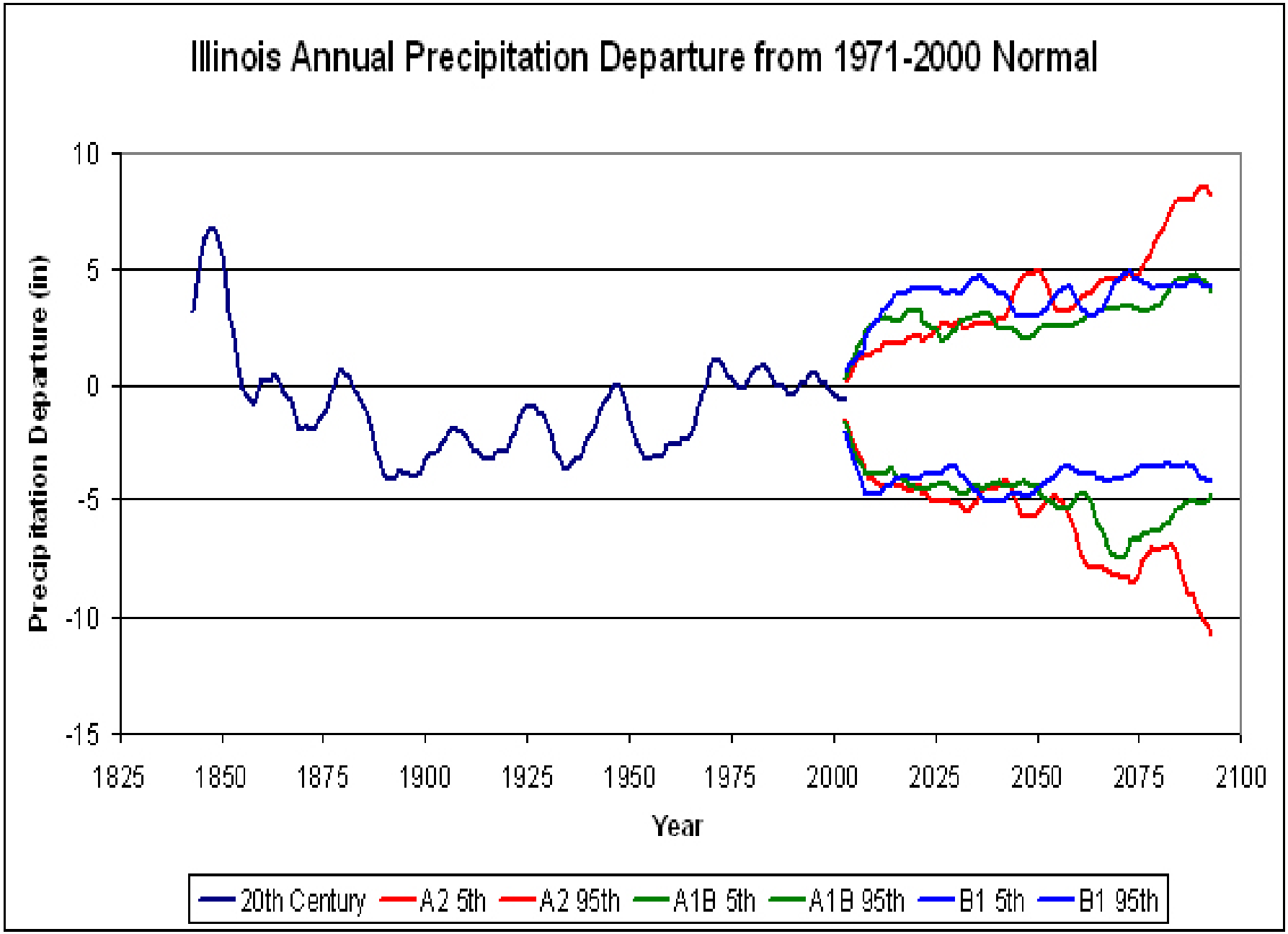
CLIMATE VARIABILITY: Definition

- Variations in climate on time scales of months, years, decades, centuries, and millennia. Includes droughts and floods.

CLIMATE CHANGE: Definition

- A statistically significant change in climate over a period of time.
  - From one 30-year period to another
  - From one century to another
  - From one millennium to another
- You can’t have climate change over less than a 30-year period.
- Climate change can be a change in the mean, in extremes, or in frequencies.


Illinois Annual Temperature Departure from 1971-2000 Normal
Temperature Departure (F)
14
12
10
8
6
4
2
0
-2
1825
1850
1875
1900
1925
1950
1975
2000
2025
2050
2075
2100
Year
20th Century
A2 5th
A2 95th
A1B 5th
A1B 95th
B1 5th
B1 95th


Illinois Annual Precipitation Departure from 1971-2000 Normal
Precipitation Departure (in)
10
5
0
-5
-10
-15
1825
1850
1875
1900
1925
1950
1975
2000
2025
2050
2075
2100
Year
20th Century
A2 5th
A2 95th
A1B 5th
A1B 95th
B1 5th
B1 95th

Conclusions: Water Sources

- Shallow Aquifers
- Deep Bedrock Aquifers
- Fox River

Conclusions: Broad Issues

Research & Planning Are Needed:

- What will the demand for water be?
- How much water is available?
- What are the impacts after combining demand & availability?
- How resistant is supply to drought & climate change?

Thank You!

Look for more information and updates:

http://www.sws.uiuc.edu/wsp

E-mail me with questions:

edg@uiuc.edu

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