Investigations for Protection of Water Availability, Kane County, Illinois

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Presentation Outline

- Background
- Selected products and efforts

Project Participants

- Sponsors
  - Kane County Development Department
  - State of Illinois
- Research
  - Illinois State Water Survey
  - Illinois State Geological Survey

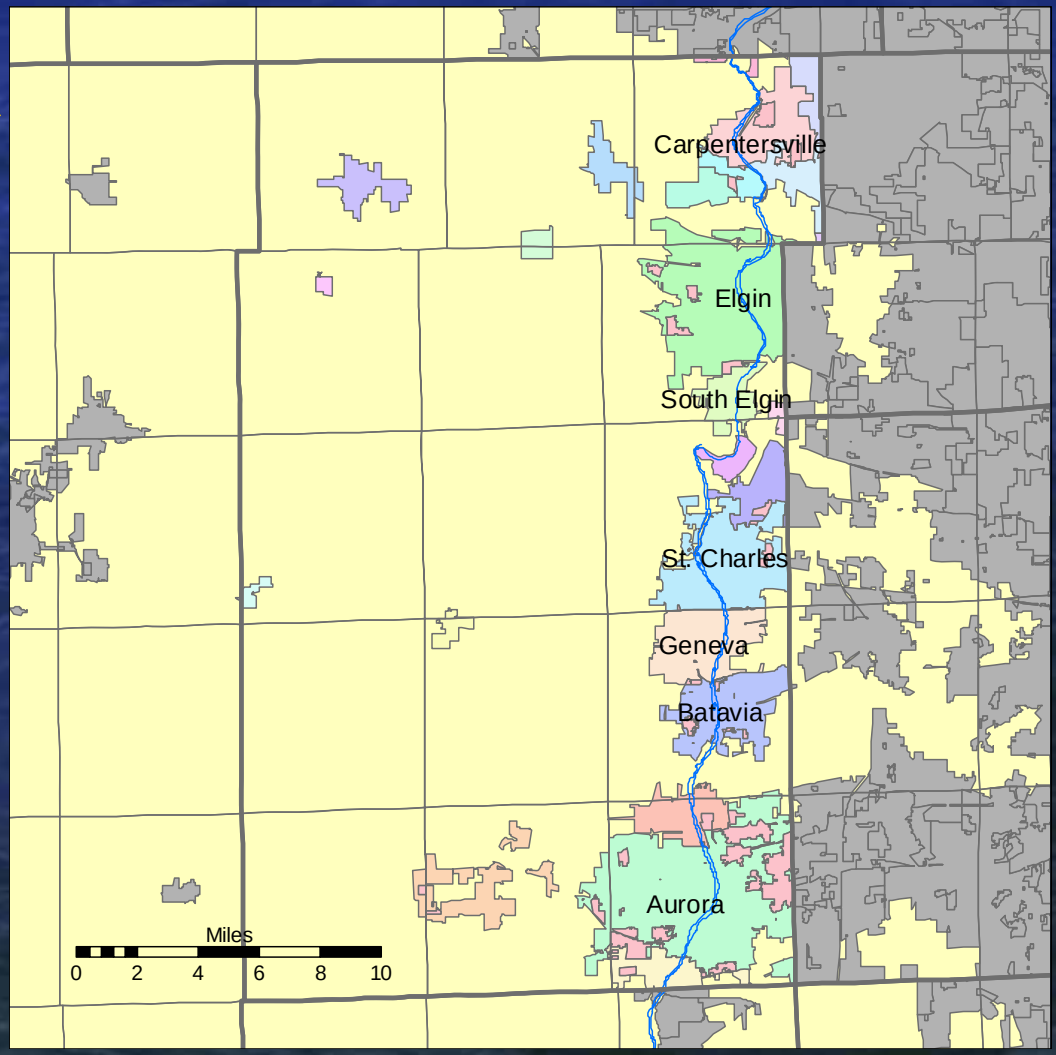
Project Objectives

To Assist Kane County In …

- Protecting water quality
- Preserving water availability
- Providing a basis for the formulation of policies and a management strategy for its water resources
- Providing baseline data and a framework for future studies

Background

- Kane County population will grow 30-40% between 2000 and 2020.
- Lake Michigan water is not expected.
- Kane County relies on groundwater and water from the Fox River.
- Effects of aquifer development not well understood.



Schedule and Products

Final Report on Geological Investigations
Final Report on Groundwater Investigations
Computer Flow Models of Aquifer Systems and Supporting Hydrologic Database

Computer Model for Surface Water Accounting and Availability

1 2 3 4 5

PROJECT START
MAY 1, 2002

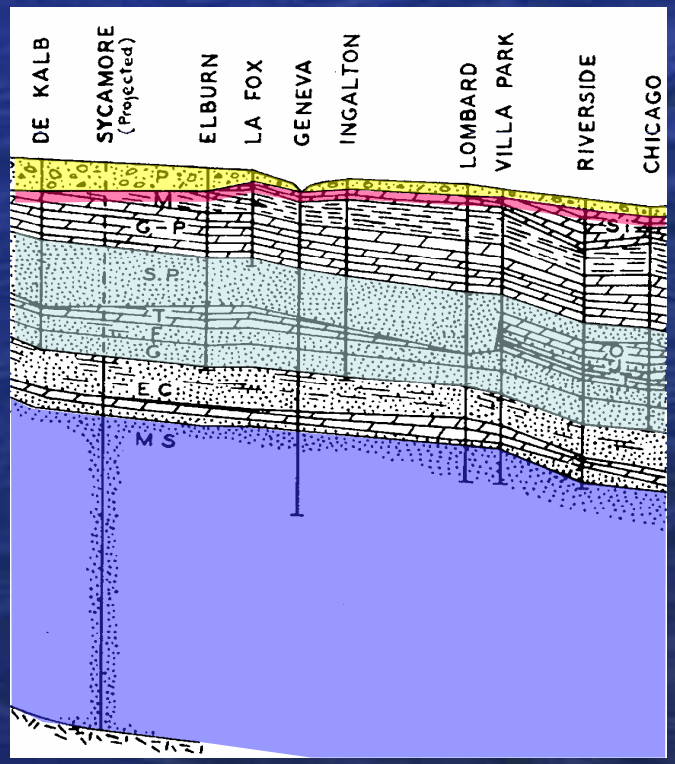
PROJECT END
APRIL 30, 2007

Interim Report on Geological Investigations

Interim Report on Three-Dimensional Geological Modeling
Interim Report on Shallow Aquifer Potentiometric Surface Mapping
Report on Temporal Changes in Deep Bedrock Groundwater Quality in NE Illinois

Aquifers of Northeastern Illinois

West East



SHALLOW AQUIFERS

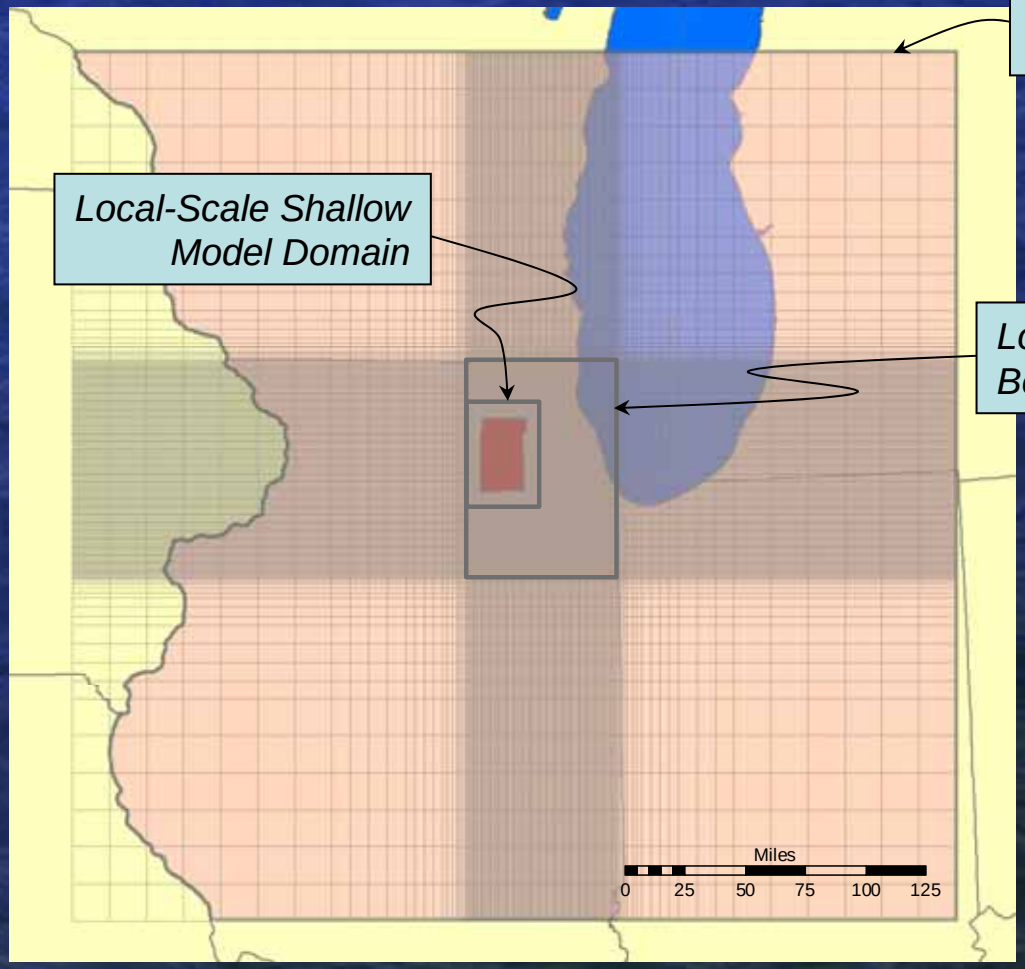
- Unconsolidated Aquifer System
- Shallow Bedrock Aquifer
- Deep Bedrock Aquifer System
- Elmhurst-Mt. Simon Aquifer

Cross-Section Modified from Bretz (1939)

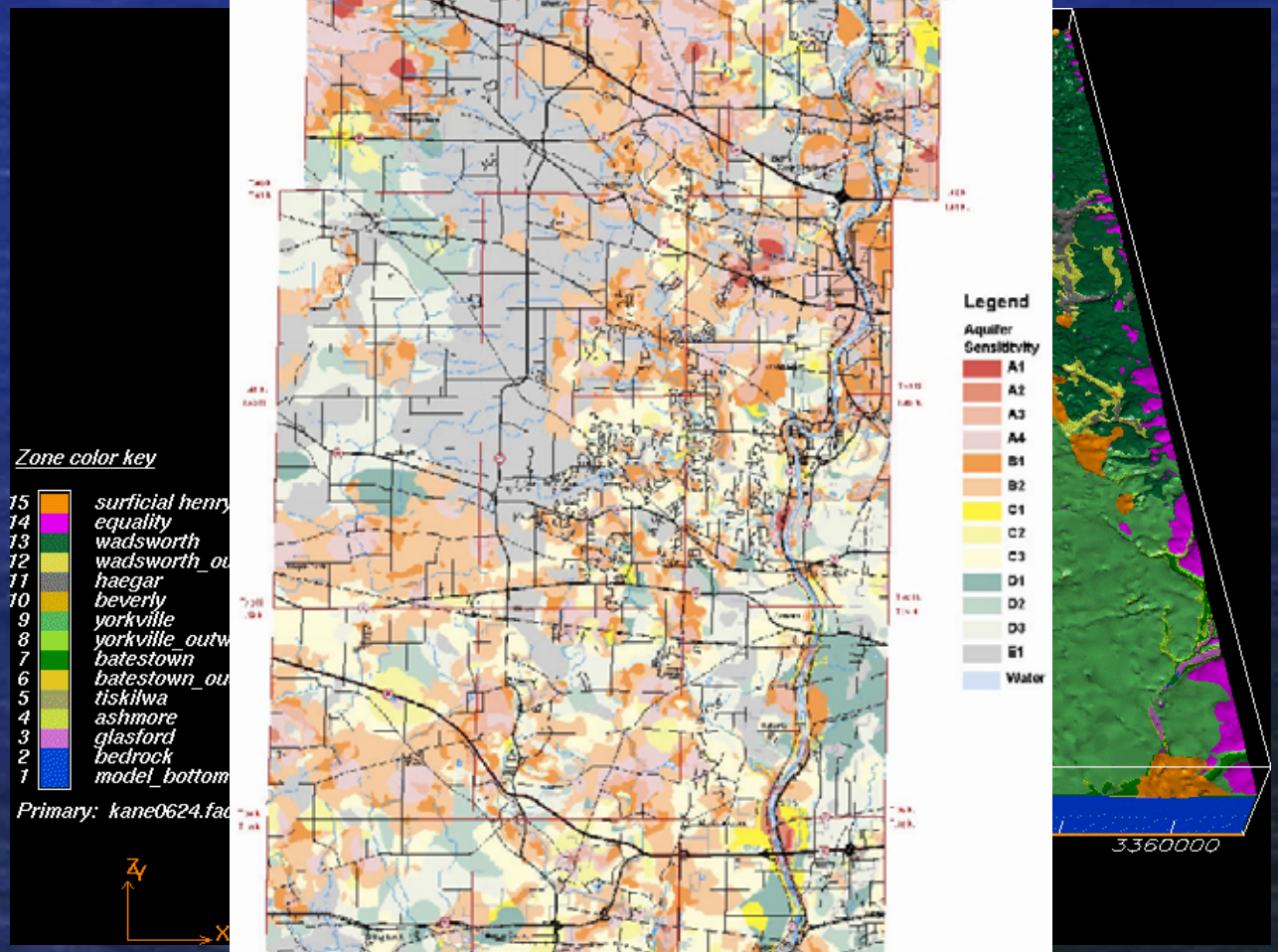
Selected Products and Efforts

- Groundwater Flow Modeling
- Geological Modeling and Mapping
- Potentiometric Surface Mapping
- Streamflow Accounting Model
- Analysis of Groundwater Availability

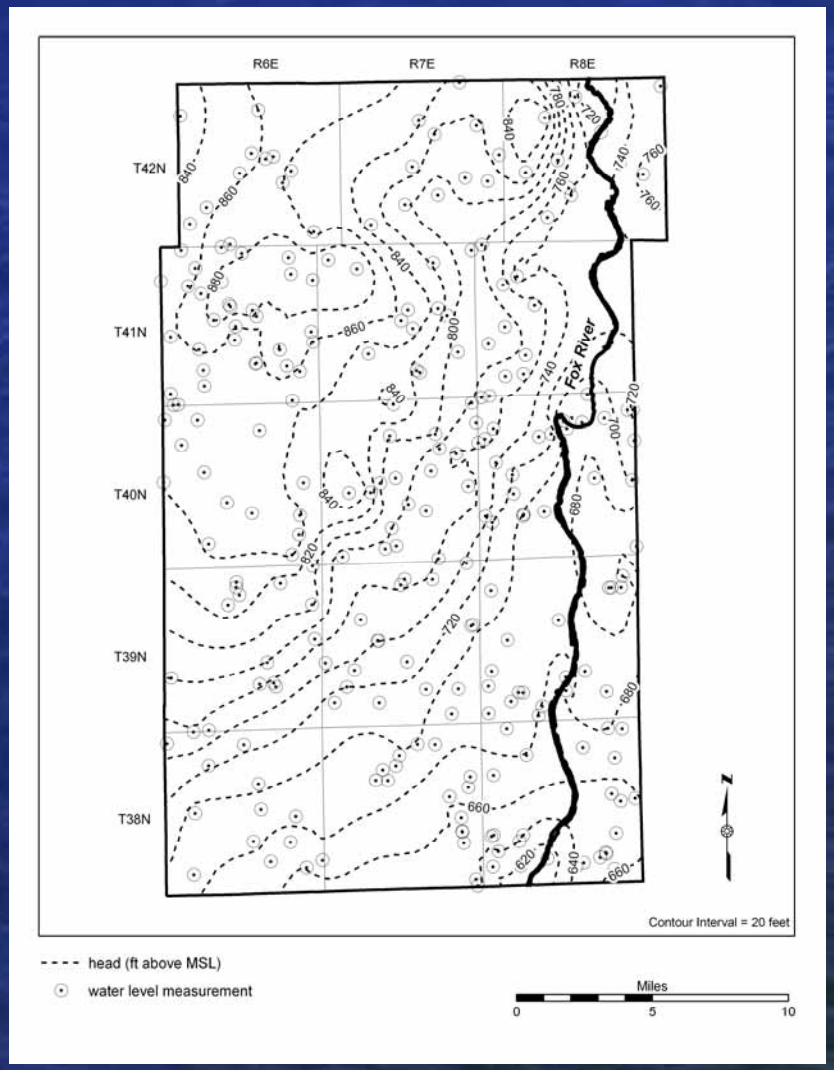
Nested Modeling Approach



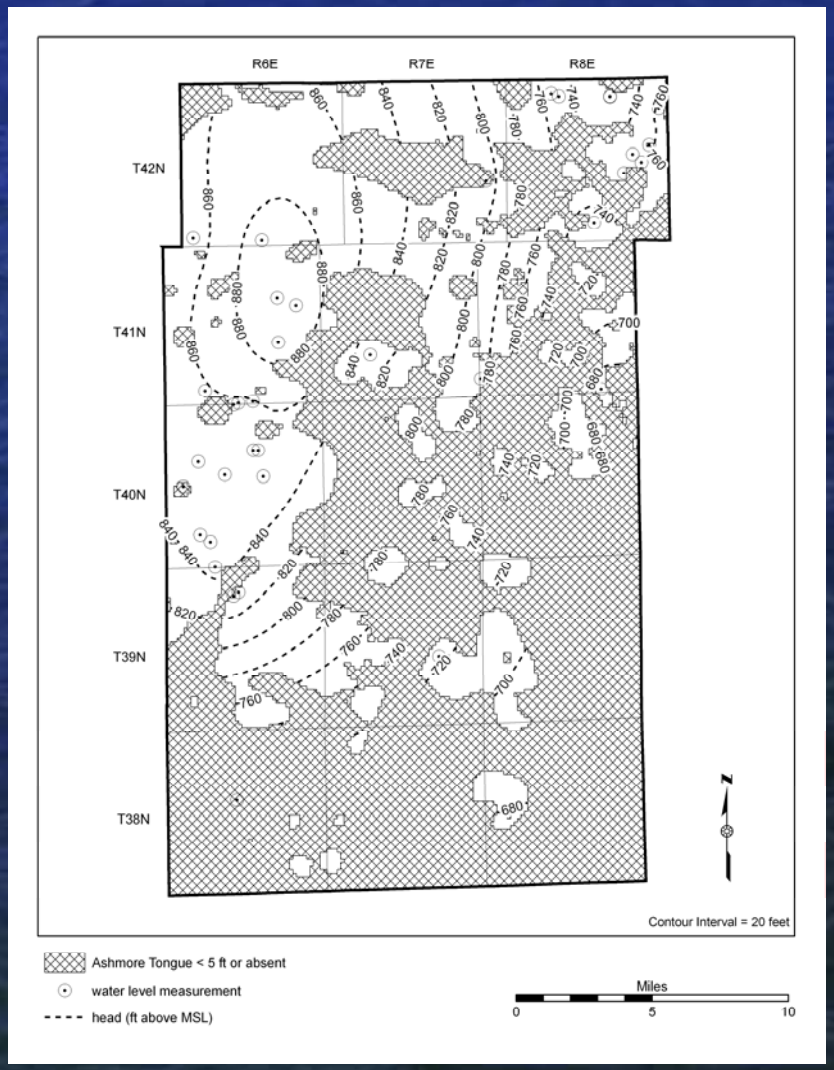
Three-Dimensional Geological Modeling



Shallow Aquifer Potentiometric Surface Mapping (Fall 2003)



Shallow Bedrock Aquifer



Ashmore Tongue (Henry Formation)

Major withdrawals and discharges along the Fox River

Largest withdrawals

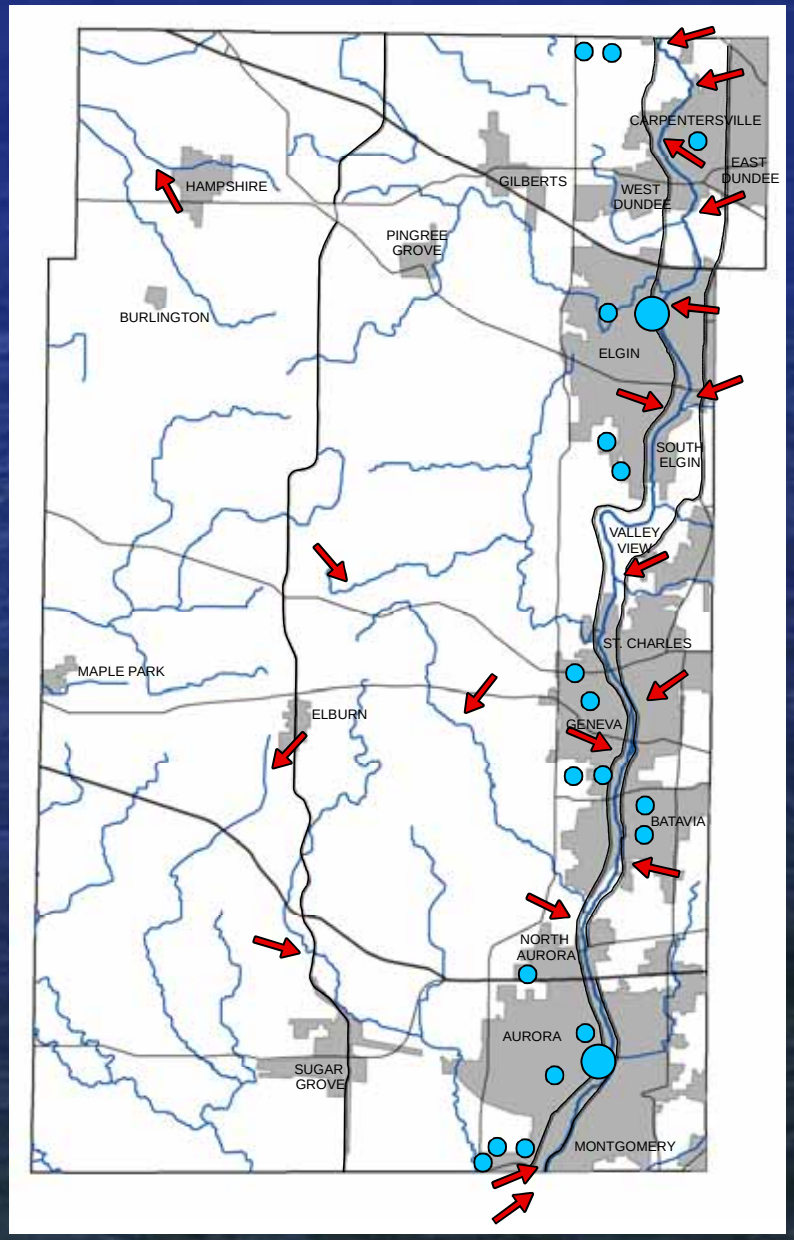
Elgin: 13.5 mgd

- 1.0 Groundwater
- 12.5 Fox River

Aurora: 17.7 mgd

- 7.5 Groundwater
- 10.2 Fox River

Major wastewater discharge sites



Accounting Model of Surface Water Quantity for Evaluating Future Scenarios of Water Use

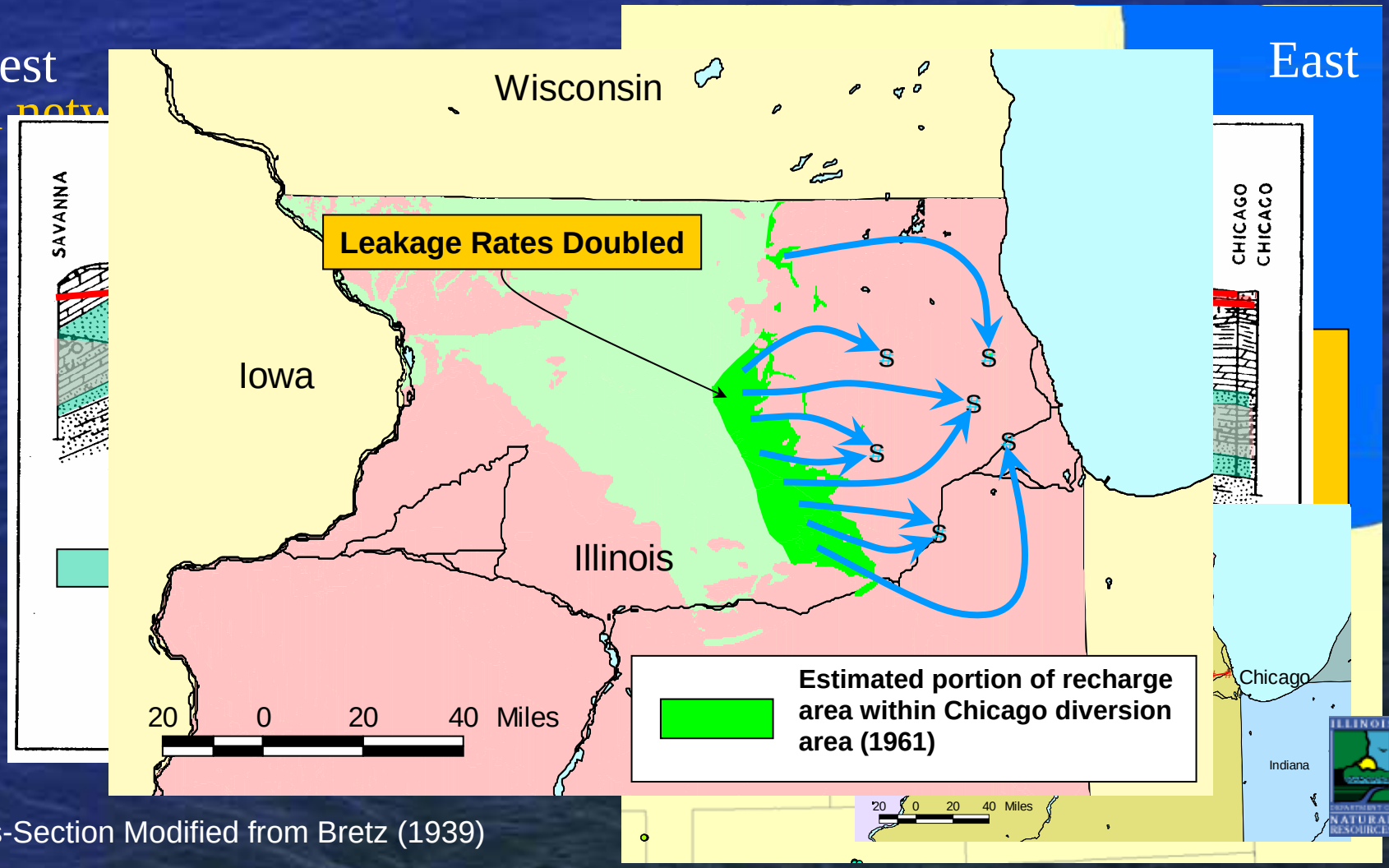
- The accounting model will be a tool to estimate impacts of changing patterns of water use on streamflow quantity
- Potential applications
  - Evaluation of water availability for instream and off-stream uses.
  - Determination of the proportion of future low flows in streams will originate from wastewater discharges (currently 20-30% for Fox River) for use in water quality investigations.
  - Examination of the impacts on streamflow of proposed changes in water supply source (e.g., switch from groundwater to surface water or *visa versa*).

Analysis of Groundwater Availability (April 2007)

- Existing Estimates
  - Deep bedrock aquifer system (Ancell Group downward through Ironton-Galesville)
  - Shallow aquifers
- Possible Estimation Procedure for Kane County

Model input files will be made available to the public so that the model can be used for future analysis of questions related to water availability.

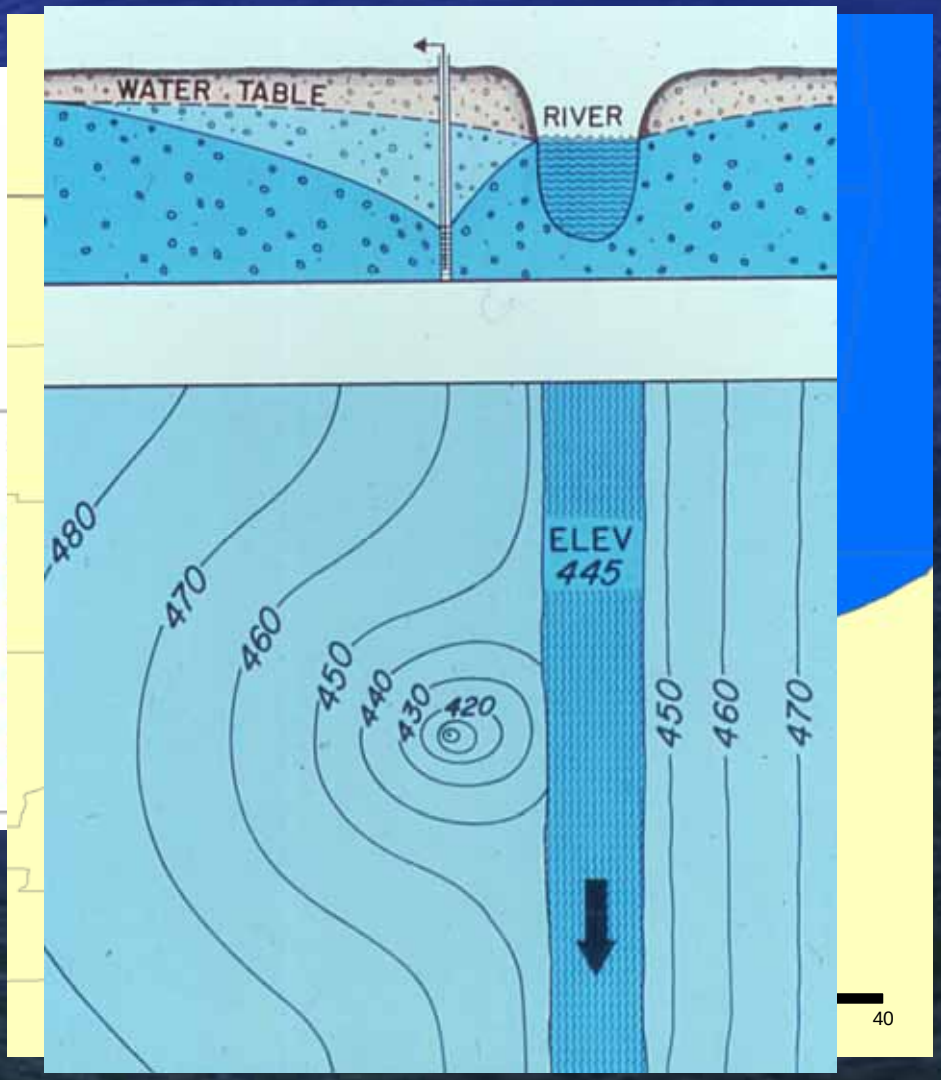
Existing Analysis of Groundwater Availability from Deep Bedrock Aquifers (*Practical Sustained Yield*) (1960s)



Cross-Section Modified from Bretz (1939)

Existing Estimate of Groundwater Availability from Shallow Aquifers (Potential Yield) (1981)

For each township shown on the map, a network of wells–ideally designed, located, and operated in concert with other wells in NE Illinois to maximize capture from either the shallow bedrock aquifer or the sand-and-gravel aquifers–will yield the amount shown forever under steady-state conditions. Recharge and leakage rates are maximized through streamflow capture.



Revised Estimates of Groundwater Availability

- Based on transient simulation carried 50-100 years into the future
- Assumed well network = real network
- Withdrawal rates will be scaled up based on population or other data
- Critical heads
  - Deep bedrock wells: 200 ft above top of Ironton-Galesville (?)
  - Shallow wells: x ft above top of aquifer
- Treatment of wells suffering head decline below critical head
  - Turn the wells off when critical head is reached, noting date
  - Let the well run, noting date
- Characterize sources of water to the well networks through time, including storage and captured streamflow

Summary

- Project due April 2007
- Approach to addressing principal questions regarding protection of groundwater quantity = nested finite-difference groundwater flow models
- Intermediate products include geologic mapping/modeling and derivative geologic maps, potentiometric surface maps, water quality studies, and streamflow accounting model
- Questions of groundwater availability will be addressed through model analysis taking into account impacts to streamflow and availability of water from storage in the deep bedrock aquifers