

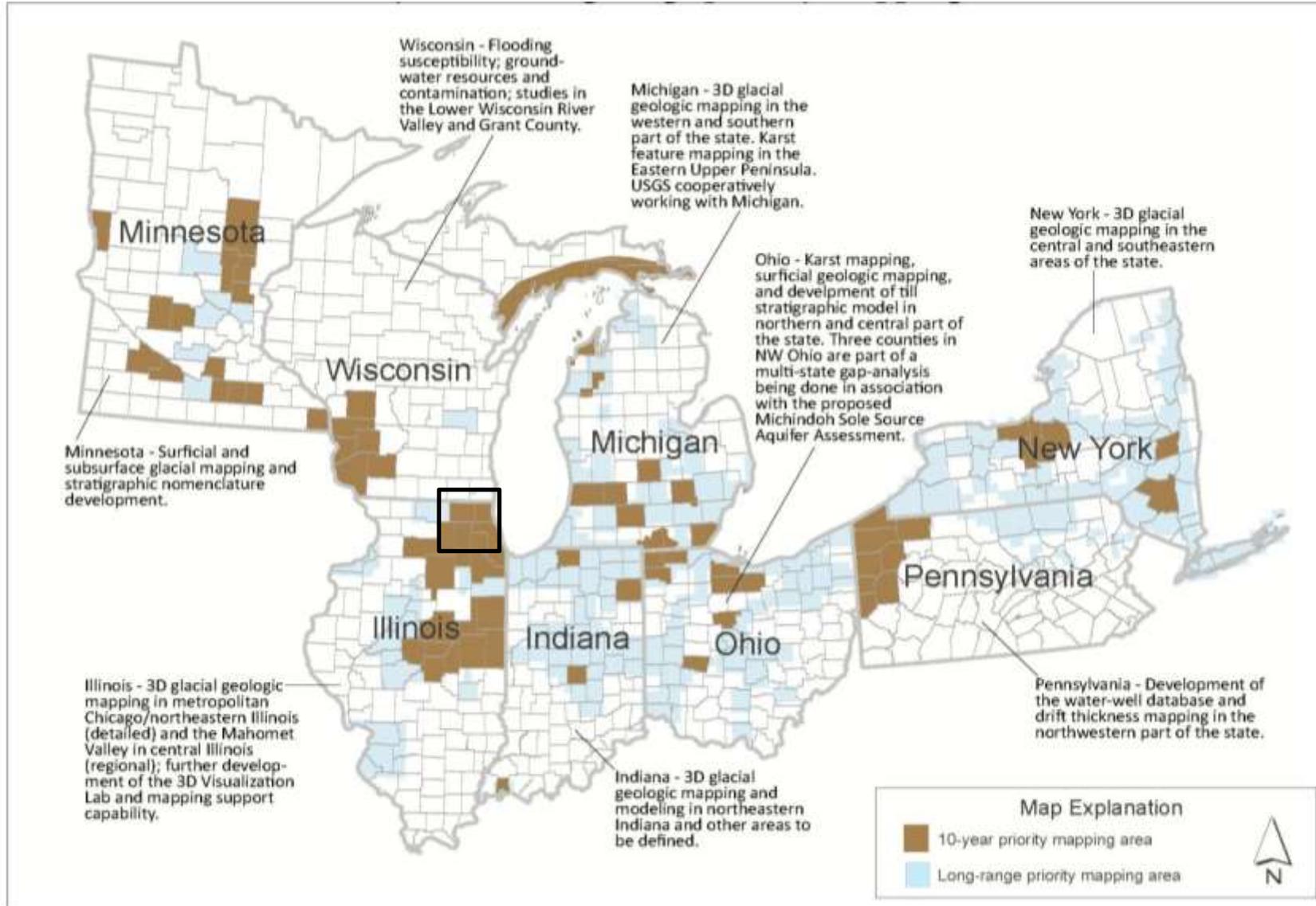
# 3-D Geologic Mapping for Water Resource Planning in McHenry County, Illinois

A case study from the Great Lakes Geologic Mapping Coalition

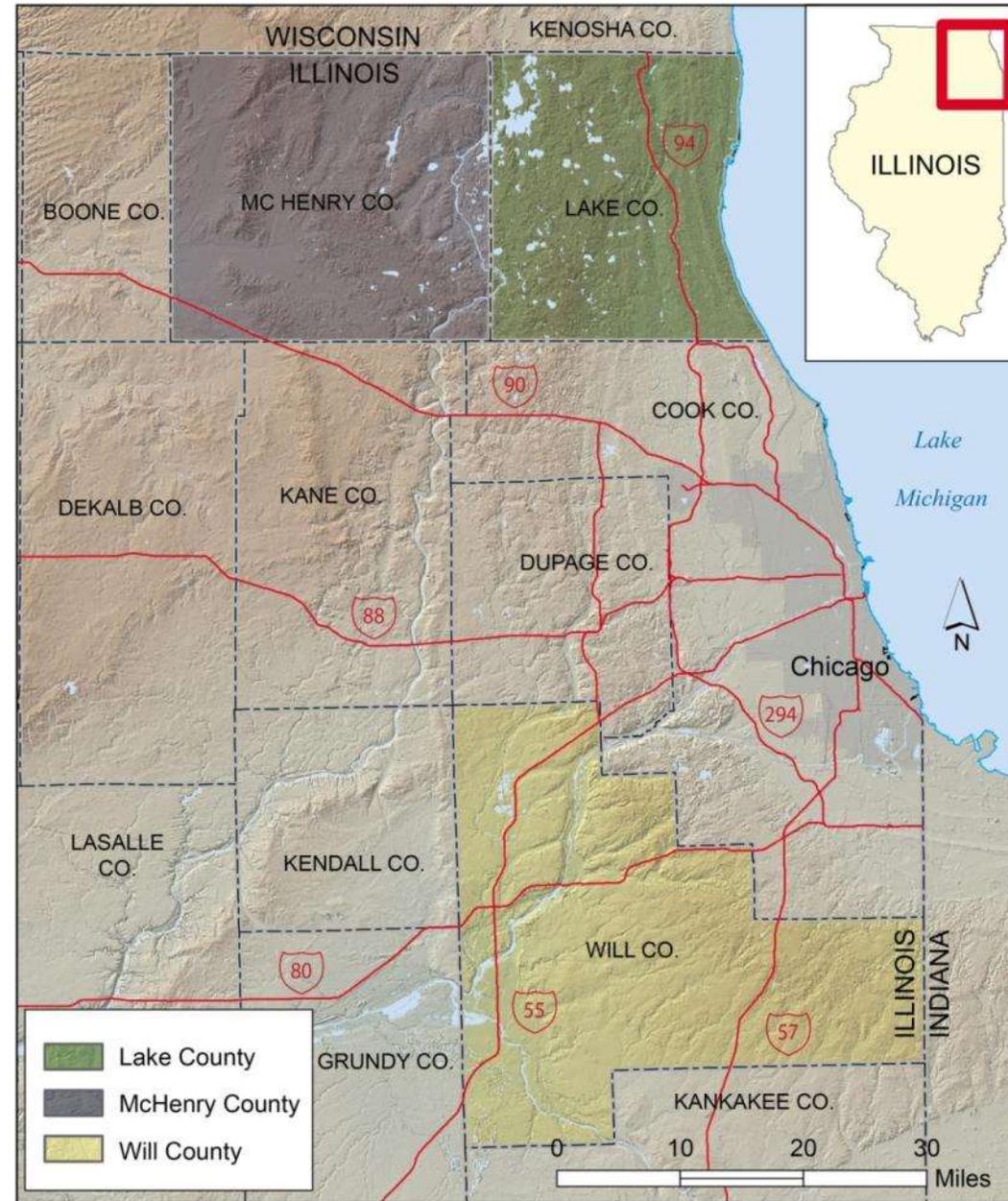


Jason F. Thomason  
Illinois State Geological Survey

# Great Lakes Geologic Mapping Coalition (GLGMC) Mapping Priority Areas



# GLGMC-Funded 3-D Mapping Projects in Illinois



# Water Supplies in Northeast Illinois

- McHenry County's need for science-based, sustainable water supply management.
  - **100% groundwater-dependent (~75% sand-gravel aquifers)**
- Responded to County's Water Resources Management Strategy.
  - Tied to public education and involvement.
  - Recognized need to update geologic and aquifer resource and contamination potential.
- Develop a 3D geologic map(s) of shallow sand and gravel aquifer systems in the county.
  - Support of groundwater-flow modeling efforts.
  - Support county and municipal water-management decisions.

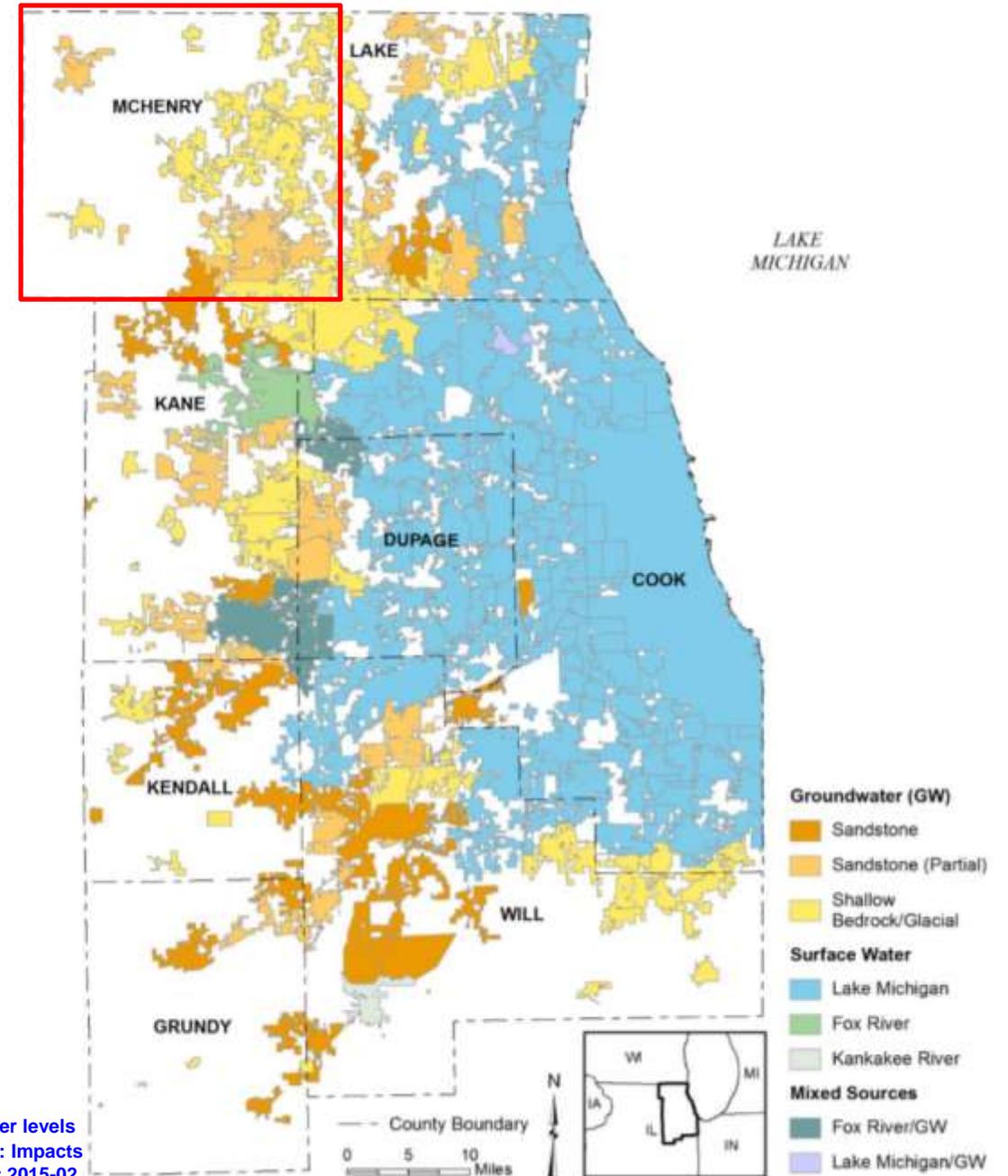
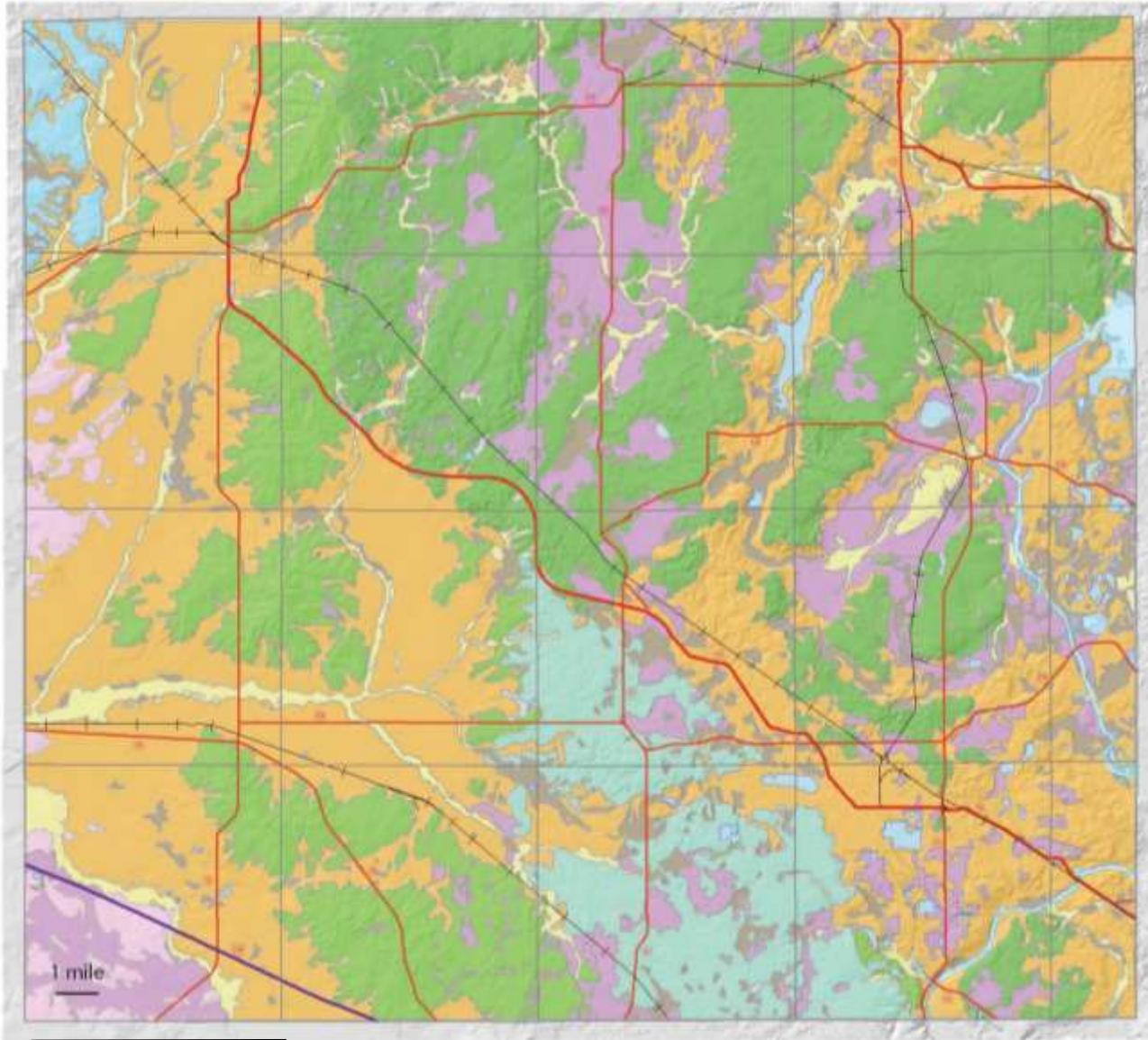


Figure from Abrams et al., 2015, Changing groundwater levels in the sandstone aquifers of northern Illinois and southern Wisconsin: Impacts on available water supply, Illinois State Water Survey Contract Report 2015-02

# Geologic Map of McHenry County



10 km

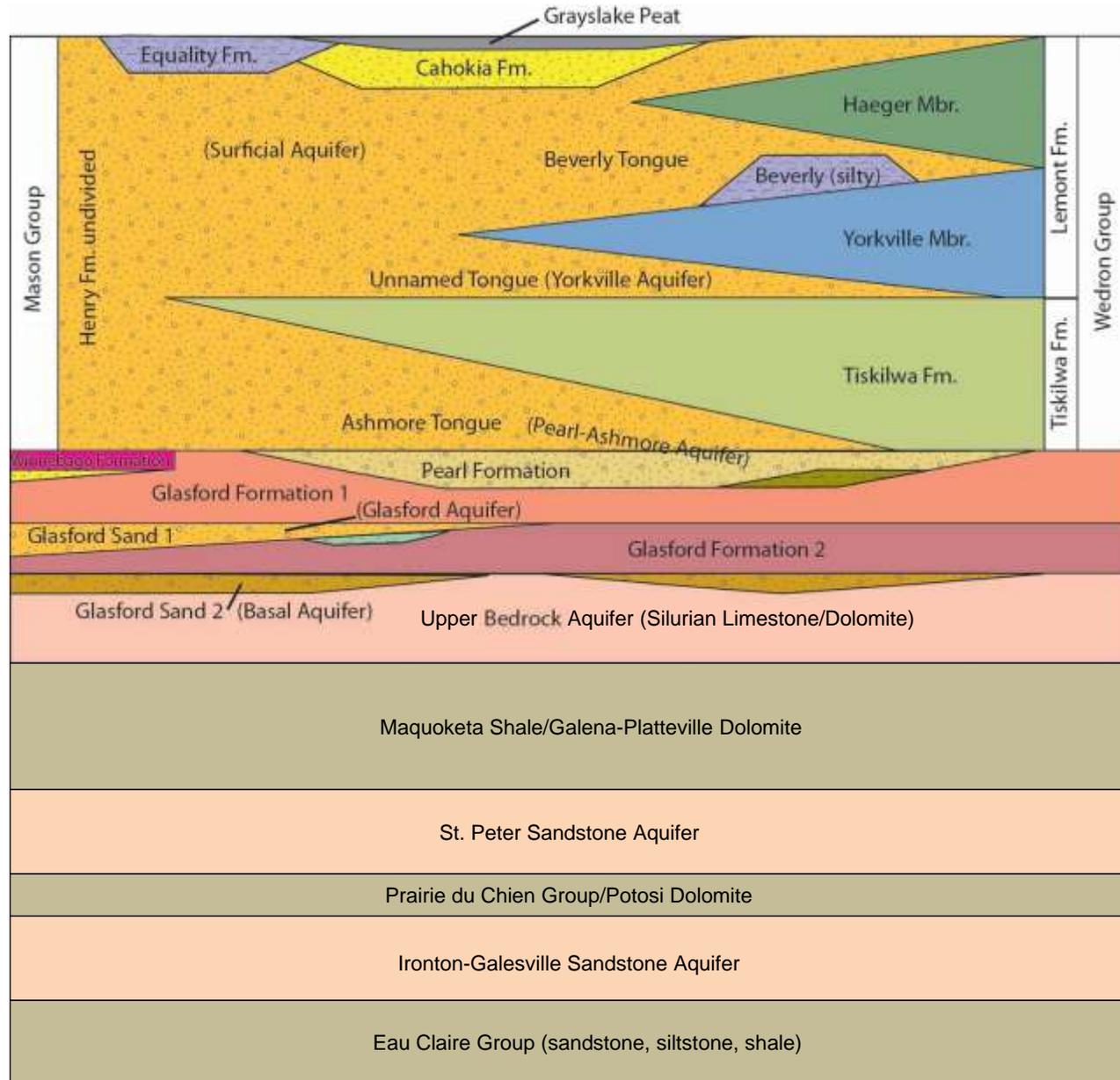
- Water
- Disturbed Ground
- Colluvium
- Grayslake Peat (peat)
- Cahokia (alluvium)
- Equality Fm (lake sedi)
- Henry Fm (outwash)
- Haeger Member (till)
- Yorkville Dm (till)
- Tiskilwa Dm (till)
- Winnebago Fm (till)
- Glasford Fm (till)



Study site



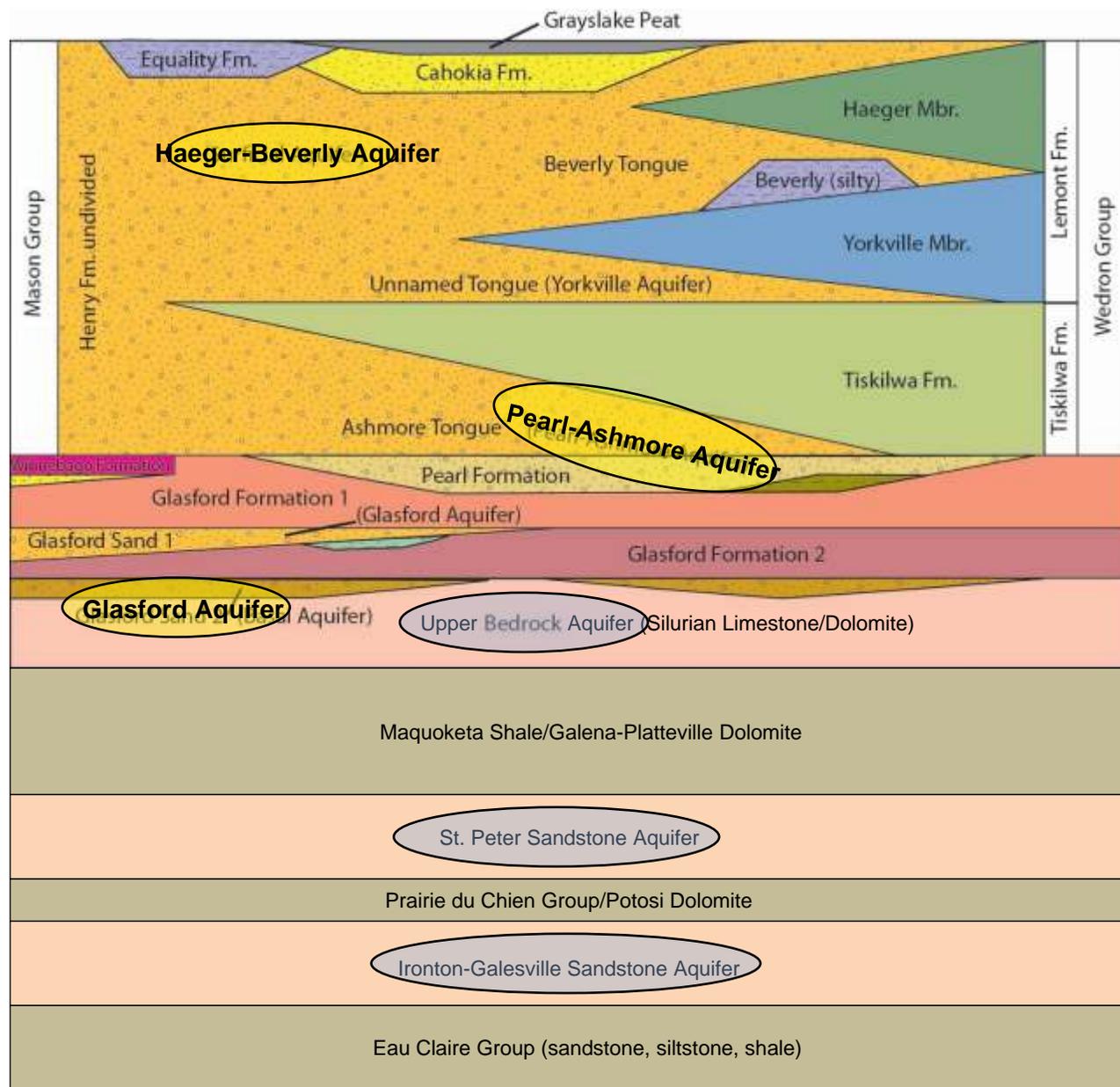
# Schematic Cross Section-Geologic Units



Shallow Sand and  
Gravel Aquifers  
0-300 ft deep

Bedrock Aquifers  
100-1200 ft deep

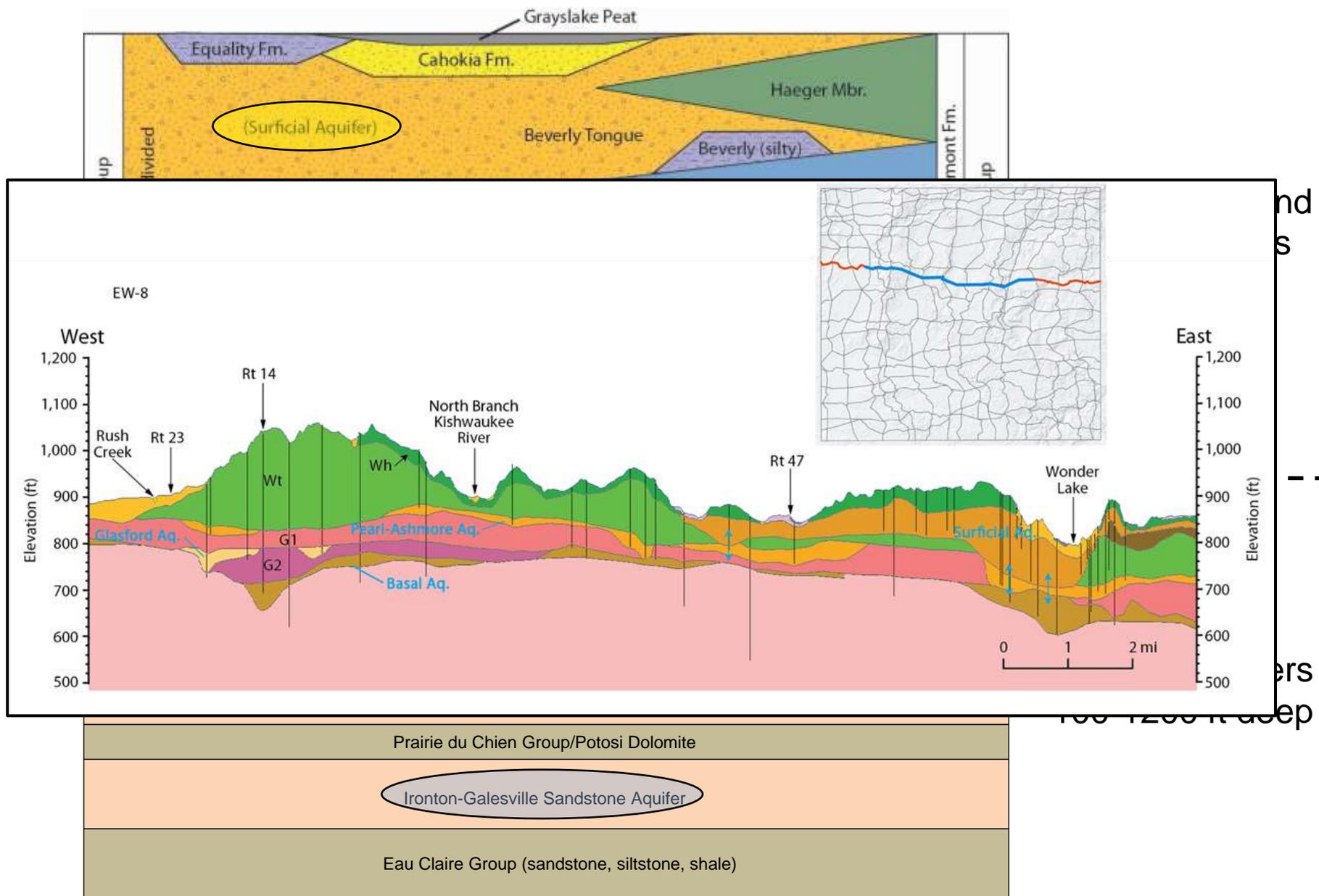
# Schematic Cross Section-Geologic Units



Shallow Sand and Gravel Aquifers  
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100-1200 ft deep

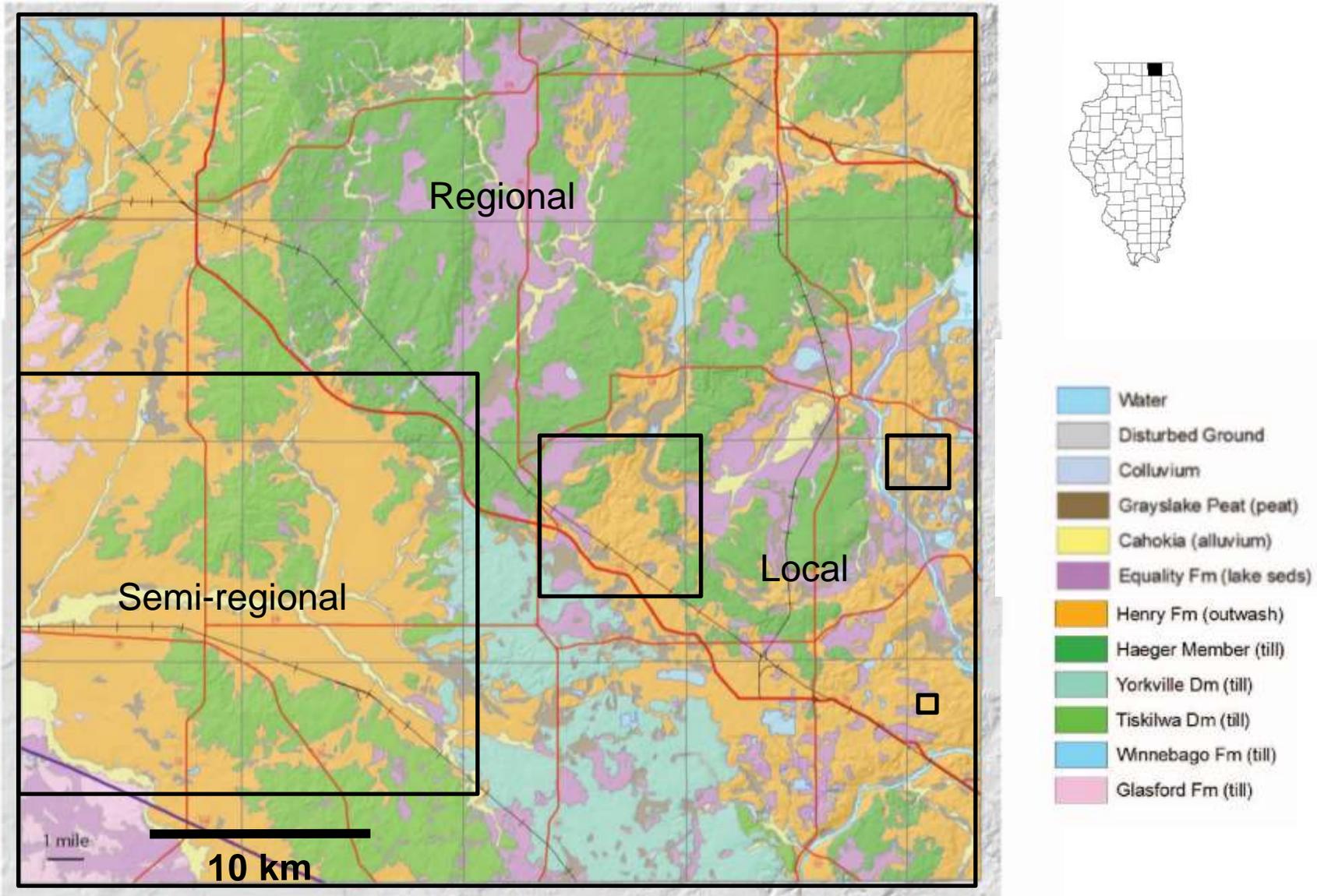
# Schematic Cross Section-Geologic Units



# 3-D Mapping Methodology

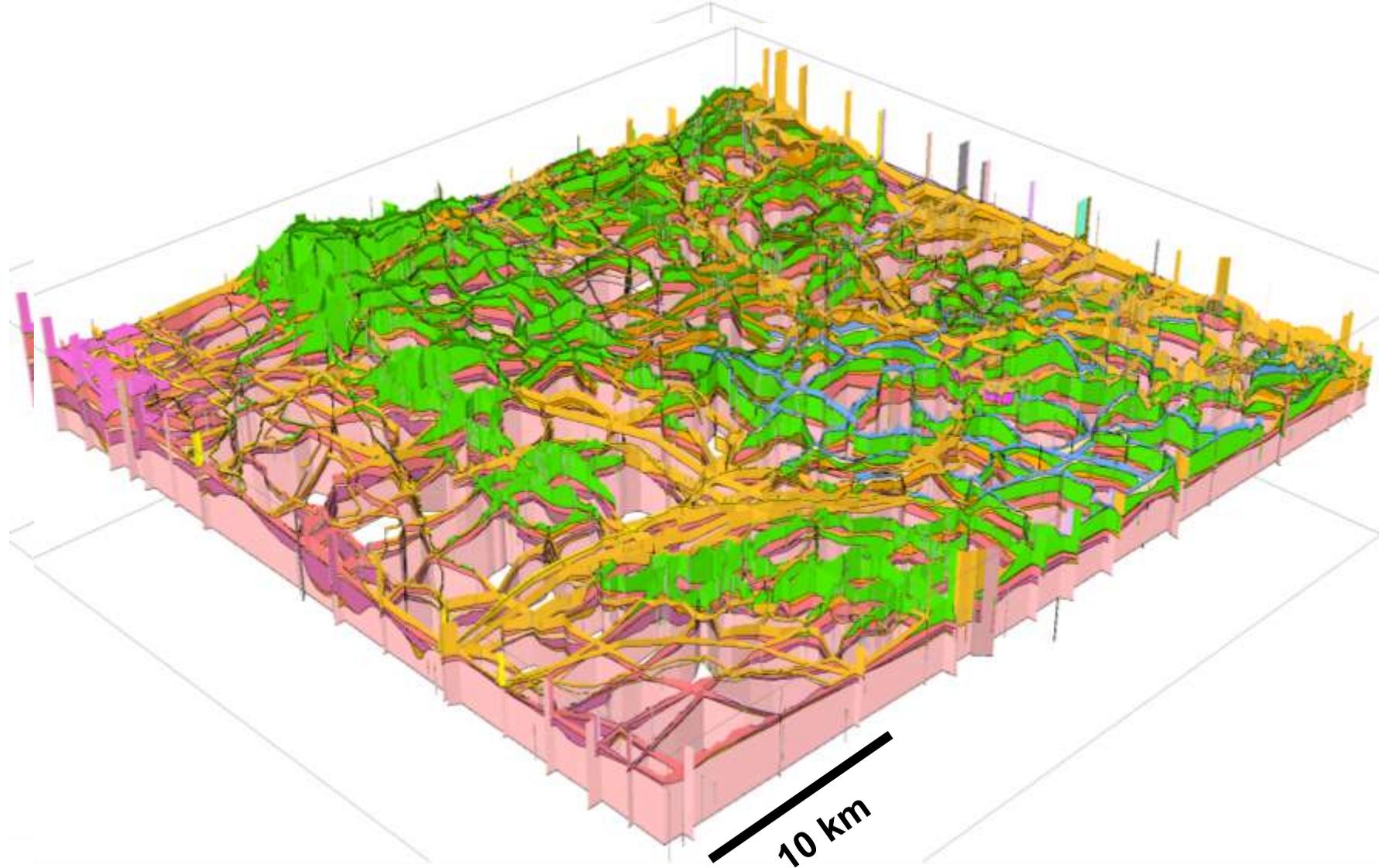
- ***Field Data Acquisition***
  - Drilling (Wireline and direct-push, 2-D Geophysics (Electrical Resistivity and Seismic))
- ***Database Management***
  - Water-well log lithologic standardization and location correction
- ***3D Visualization***
  - ArcGIS, Geovisionary, GSI3D, Subsurface Viewer MX
- ***Geologic Interpretation***
  - ArcGIS (ArcScene), GSI3D, Subsurface Viewer MX, Adobe
- ***3D Mapping/Modeling***
  - ArcGIS, GSI3D, Subsurface Viewer MX, GoCAD
- ***3D Map Product Development***
  - Cartographic Software, Subsurface Viewer, others...

# Multi-scale 3-D Geologic Mapping

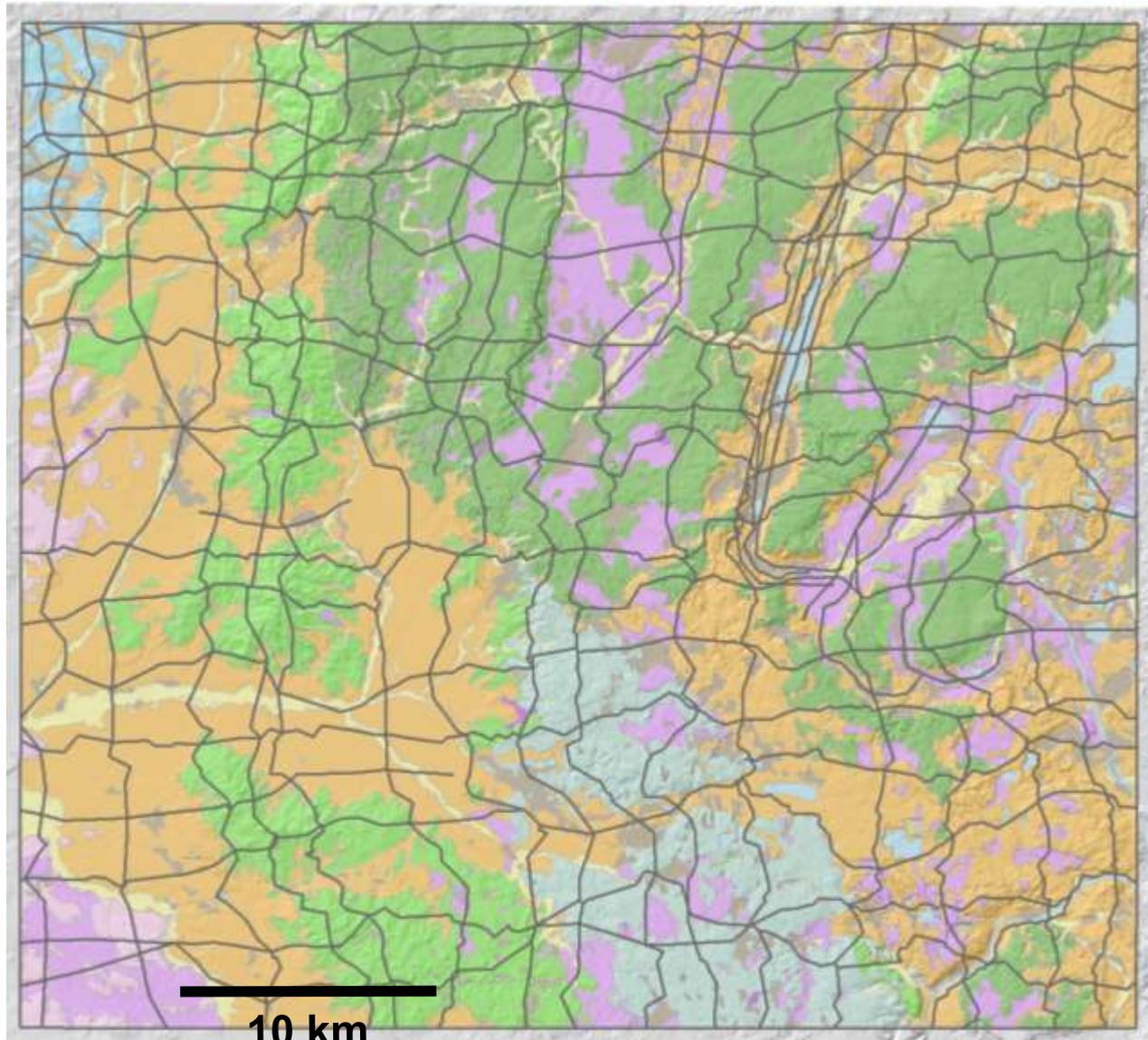


# 3D Geologic Map-Cross Section Network

Viewed from Southwest

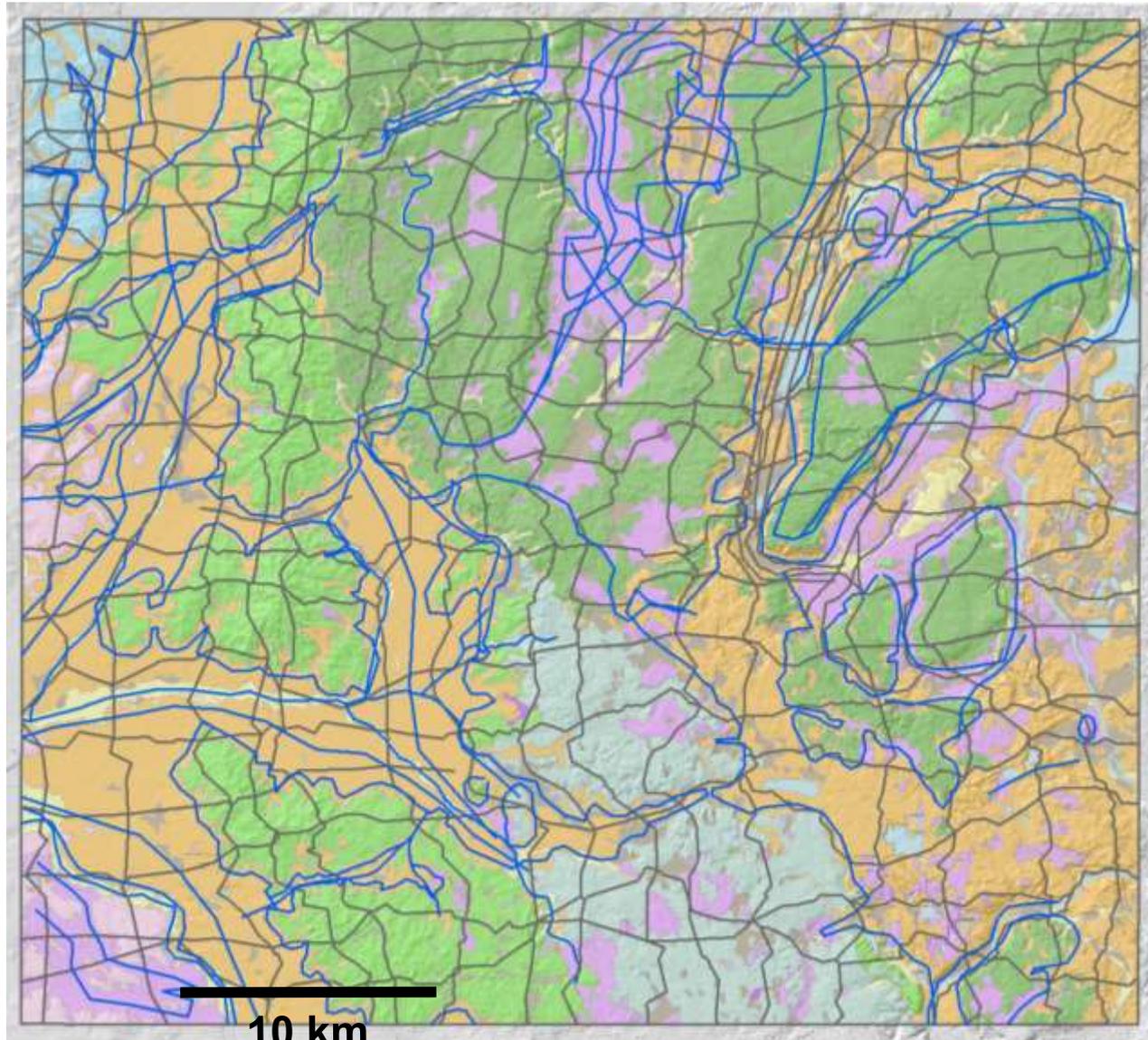


# Section-based 3-D mapping- Regional



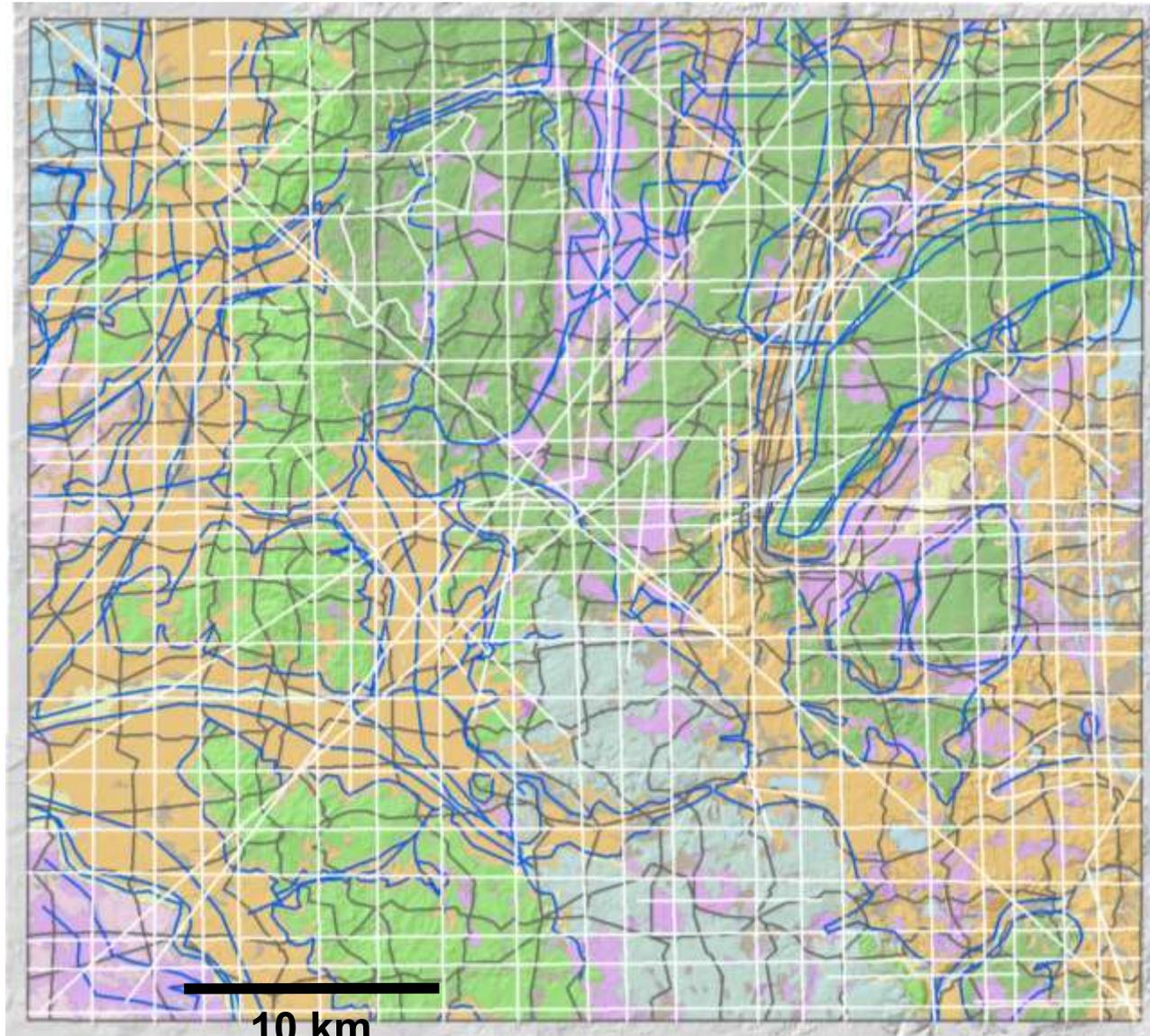
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# Section-based 3-D mapping- Regional



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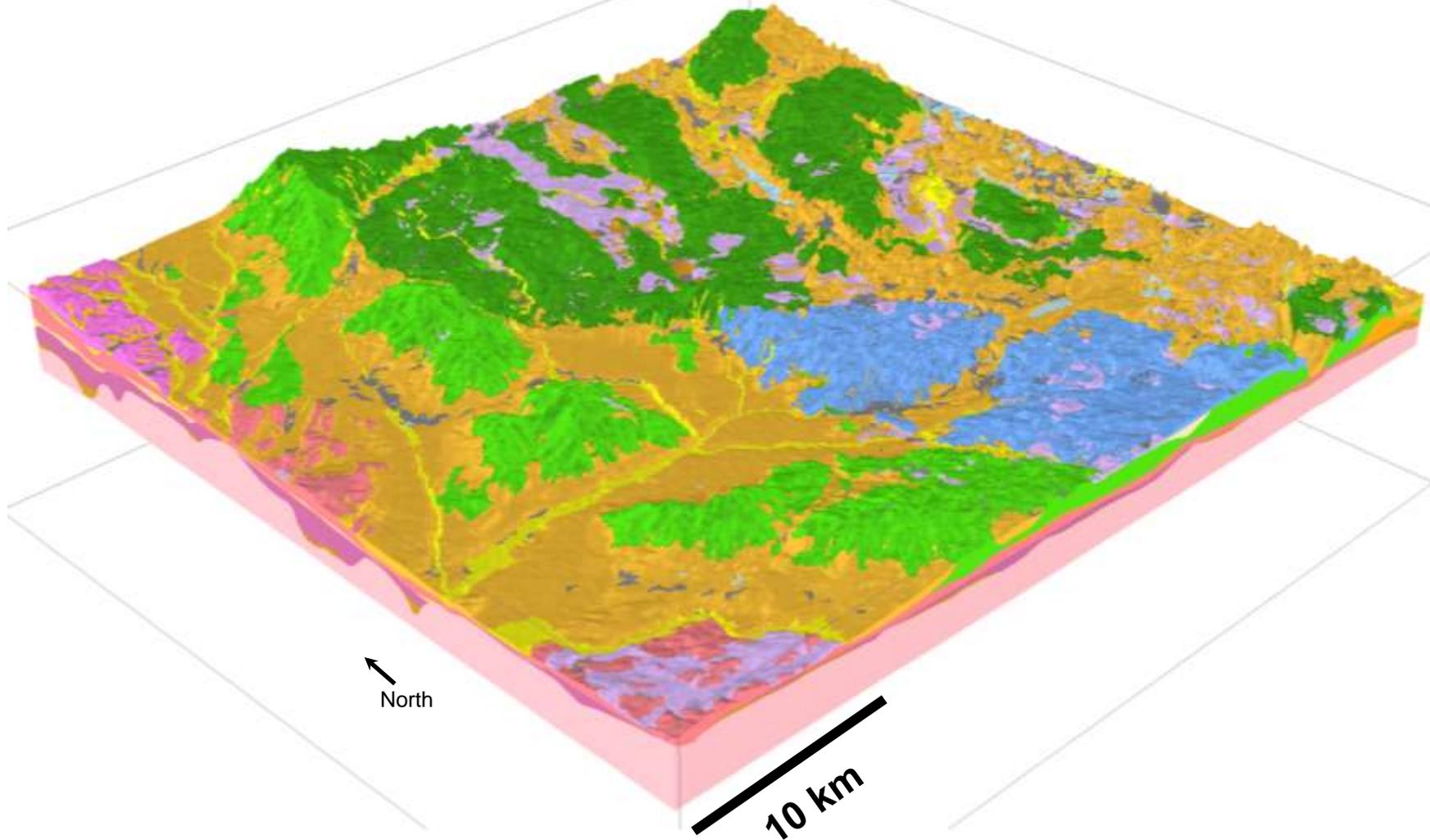
# Section-based 3-D mapping- Regional



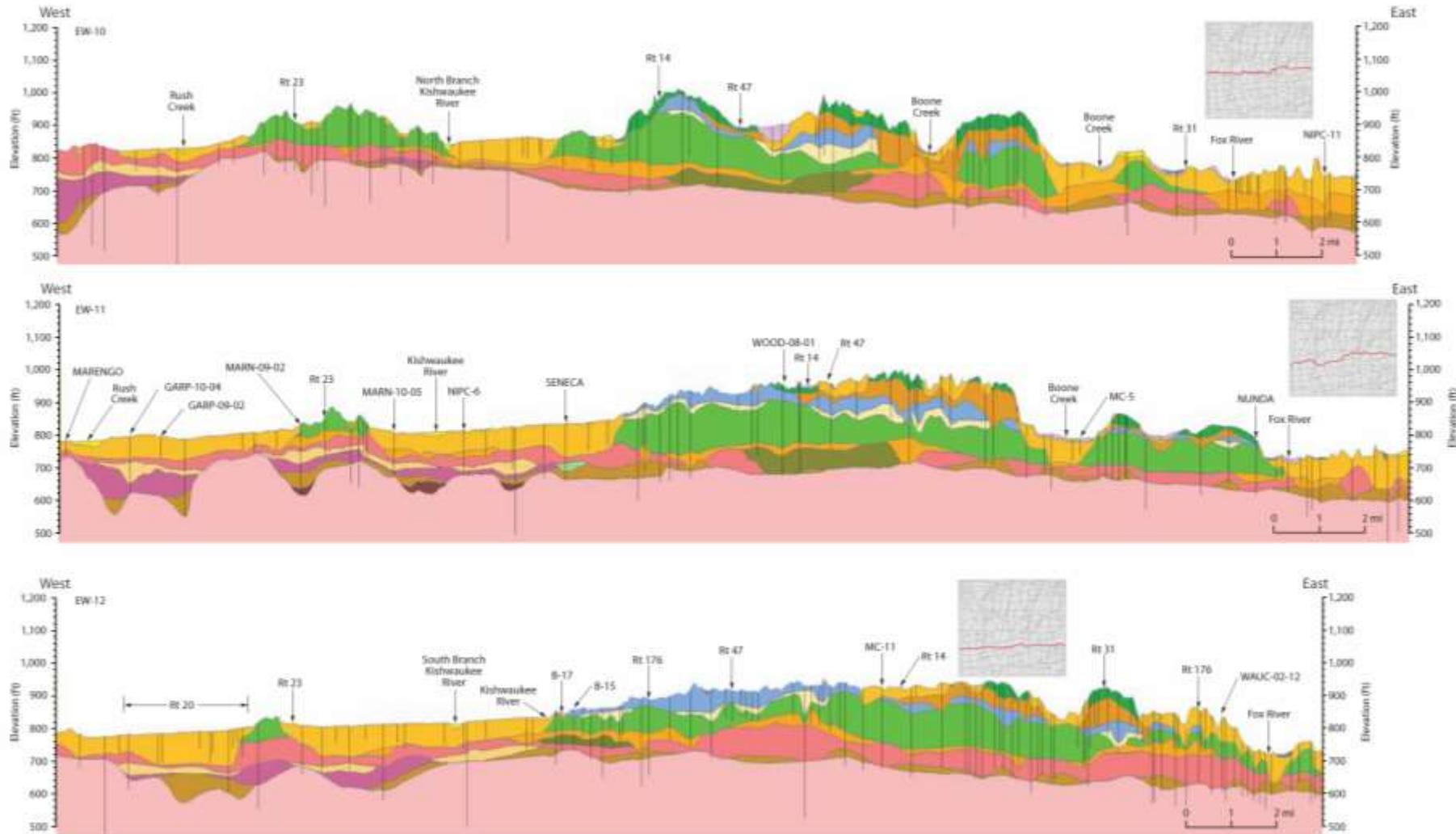
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# Regional

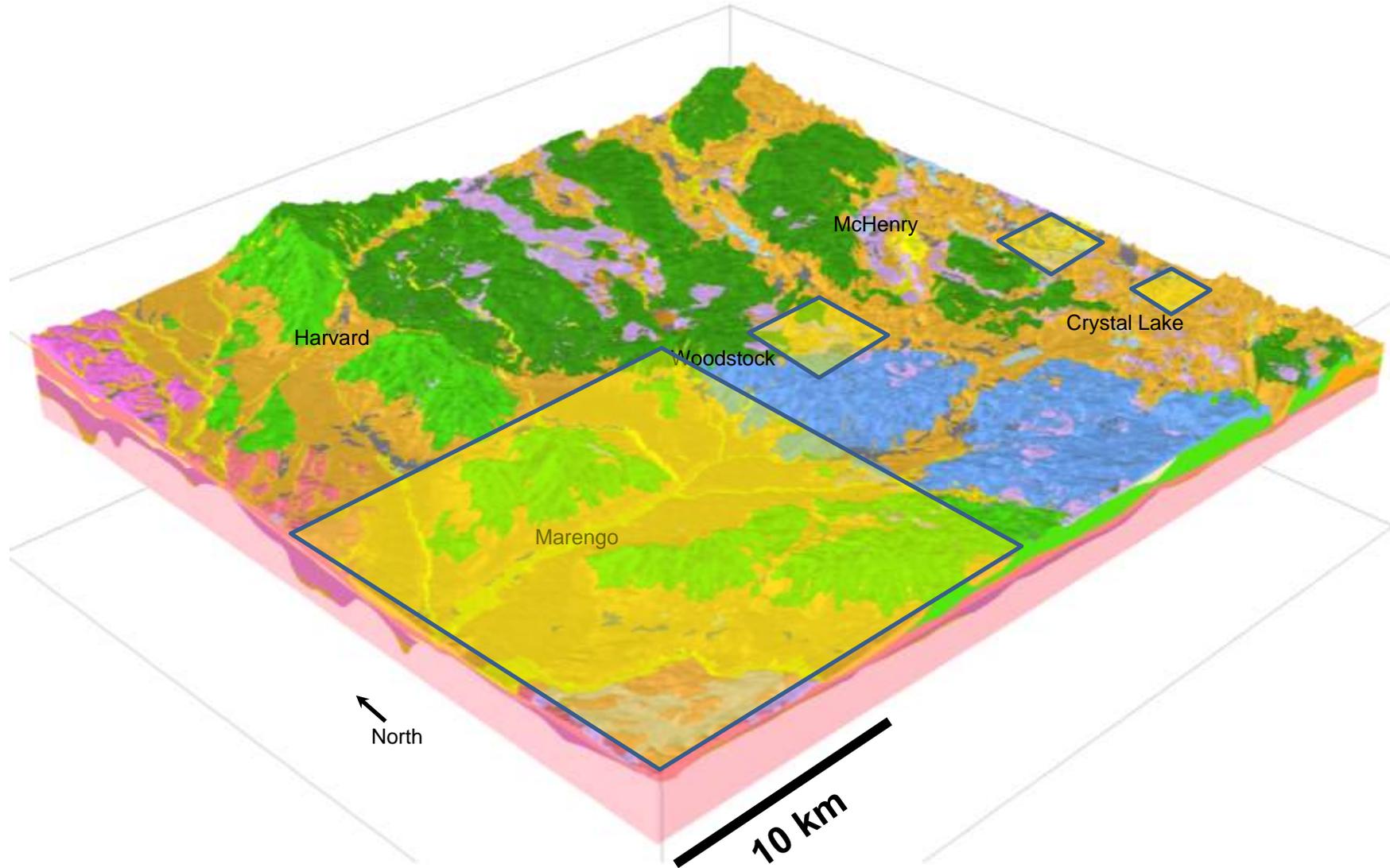
County-scale (22 geologic units)



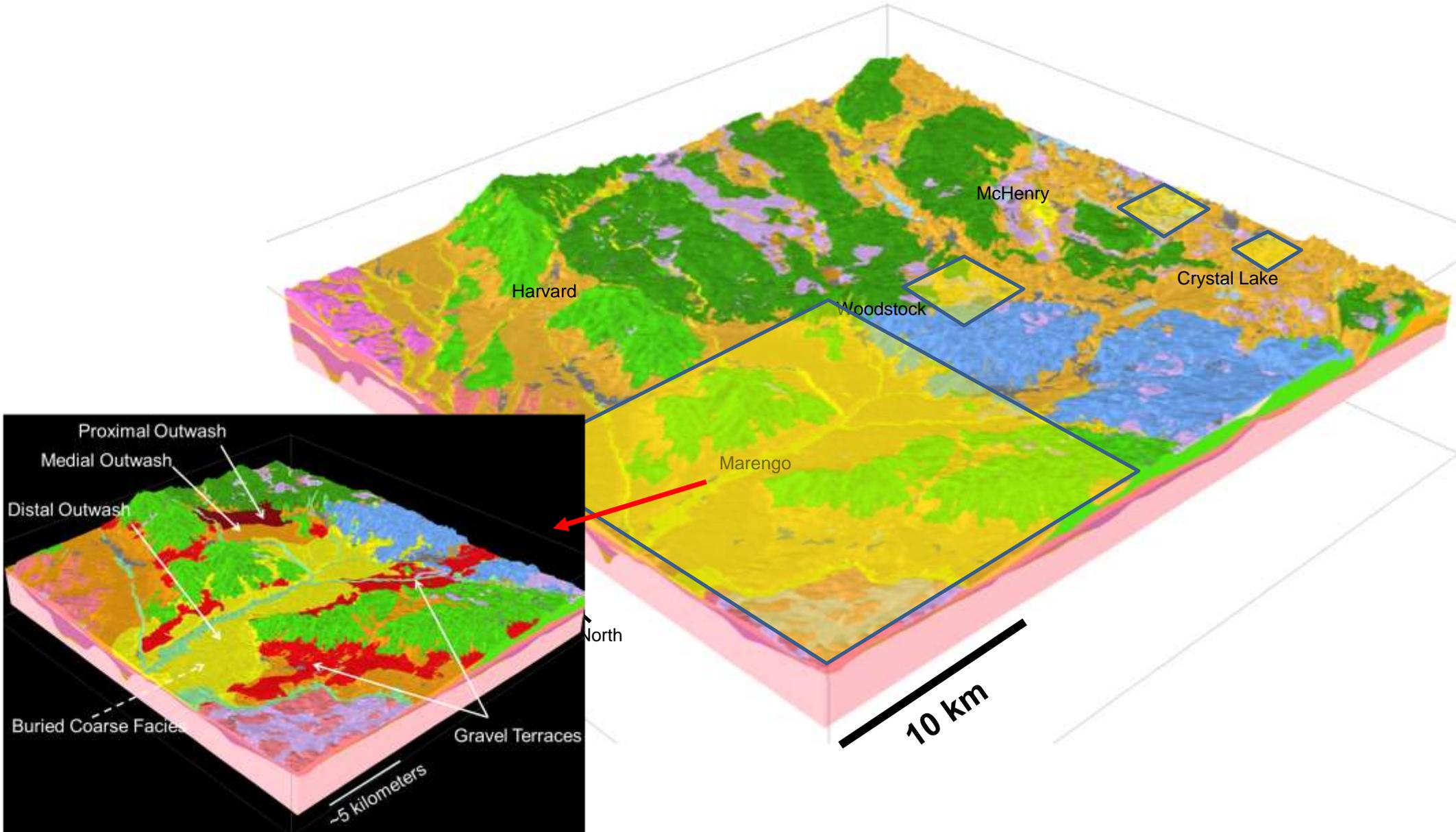
# Section-based 3-D mapping- Regional



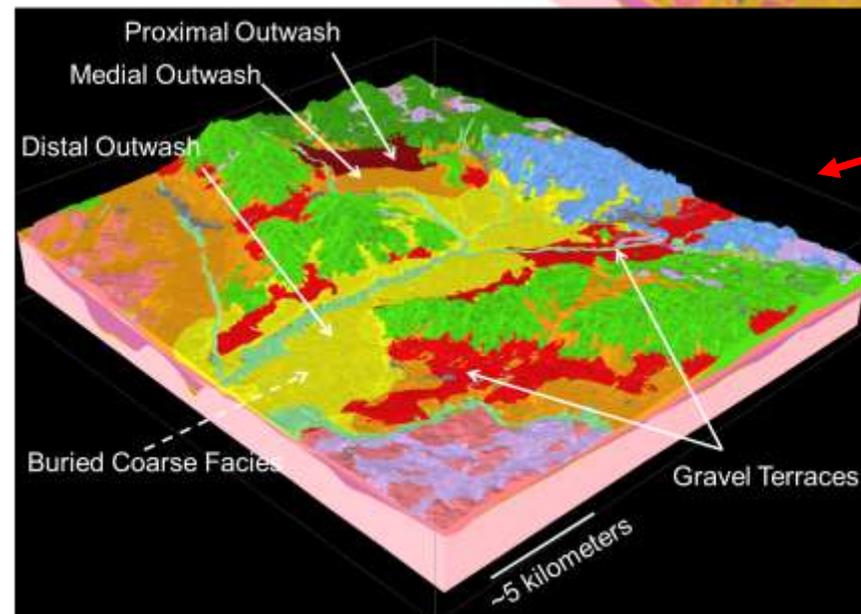
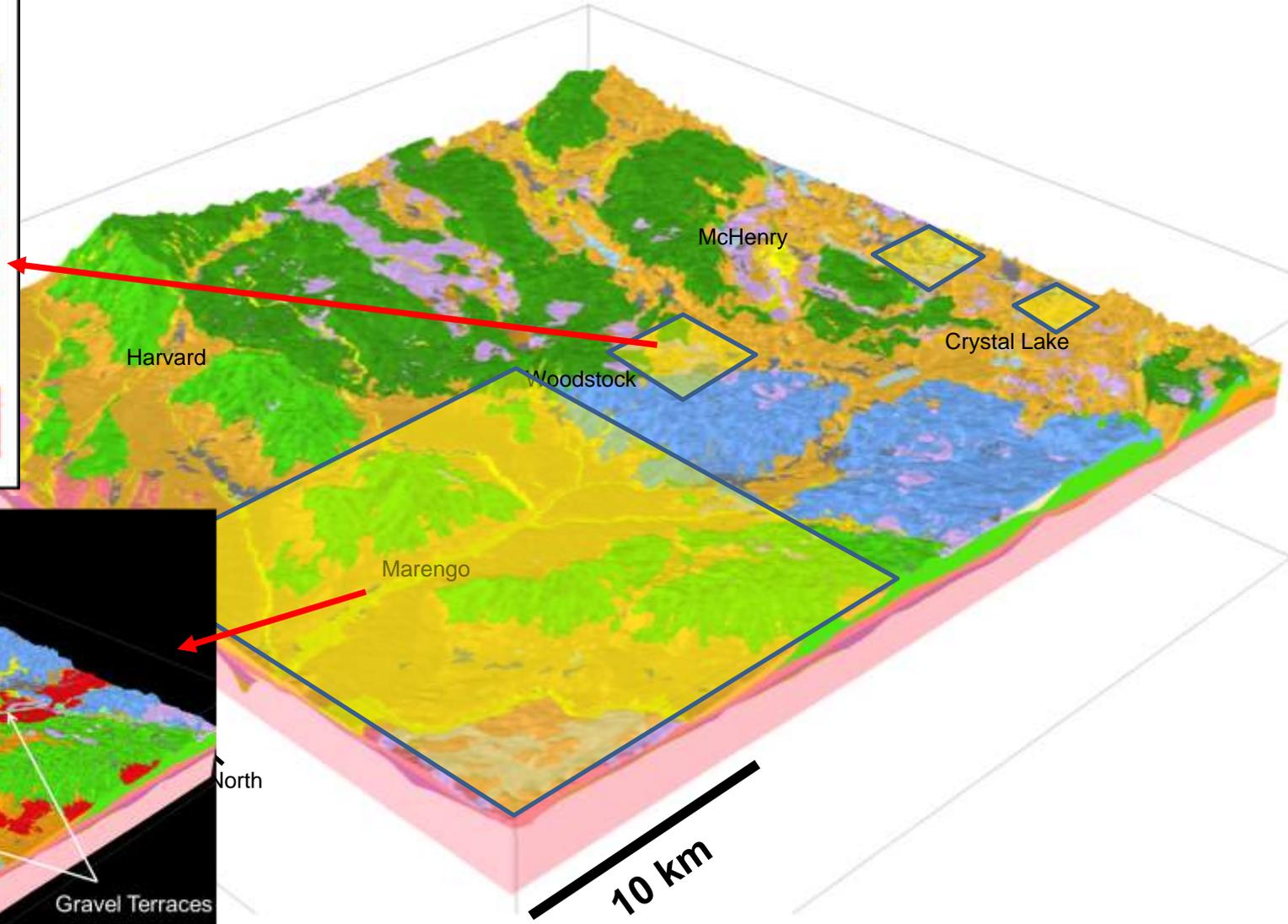
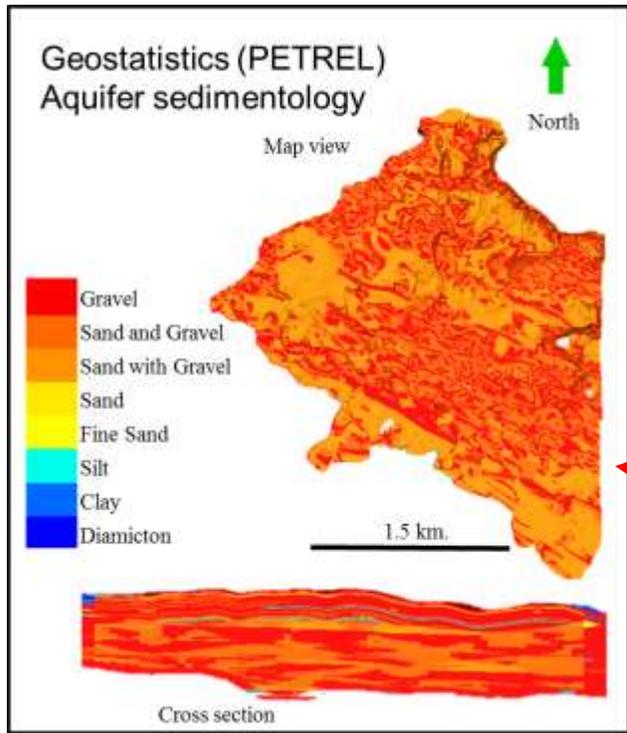
# Multiscale 3D Mapping



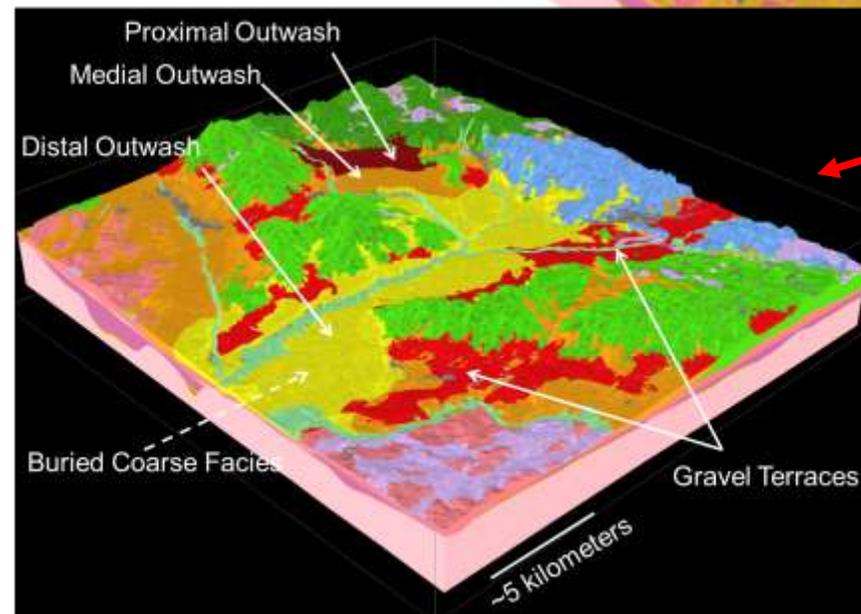
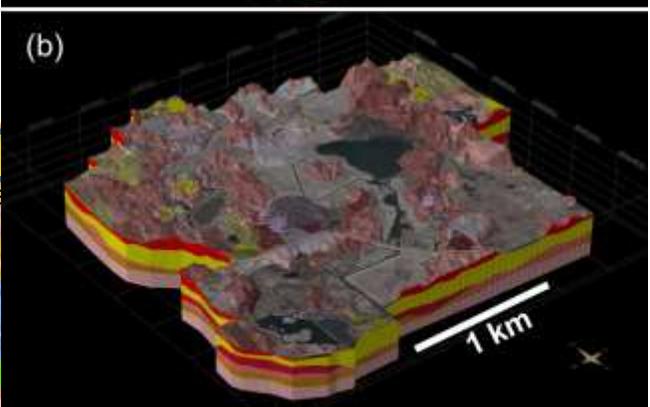
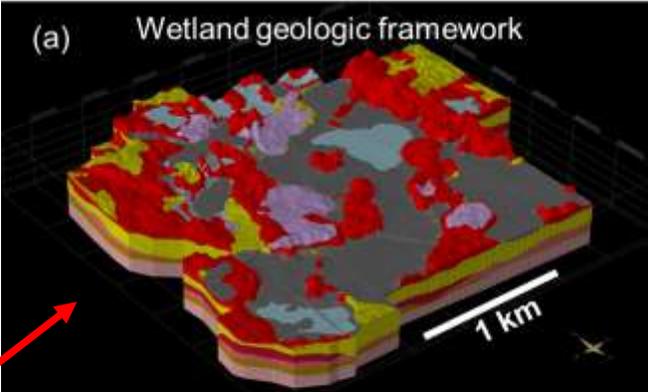
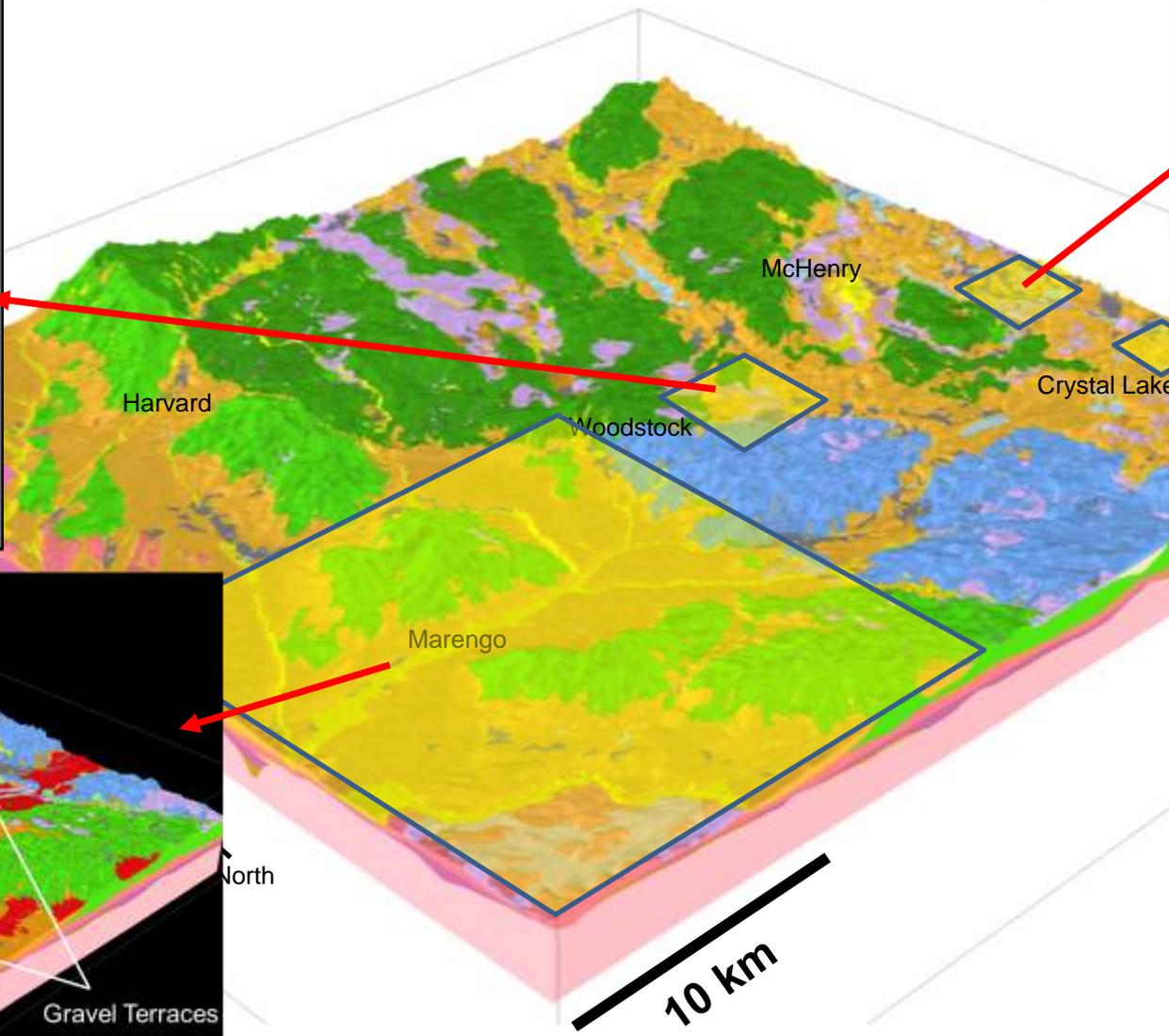
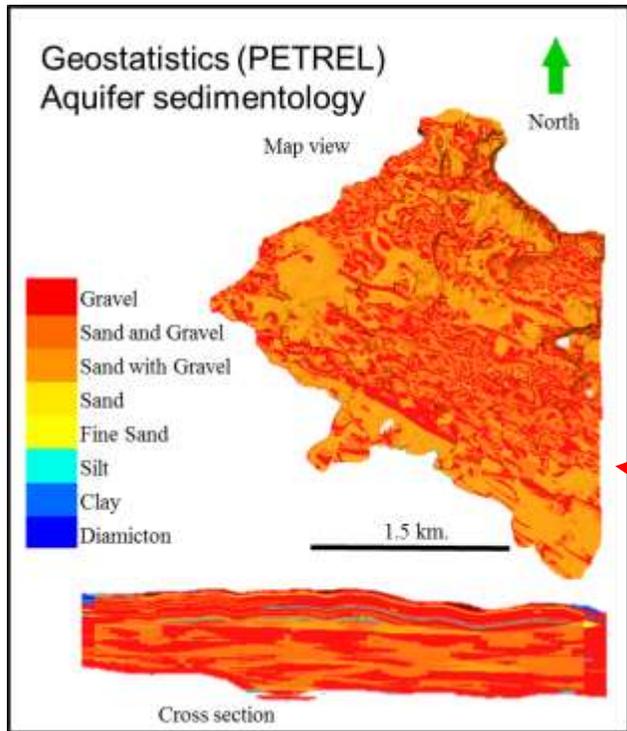
# Multiscale 3D Mapping



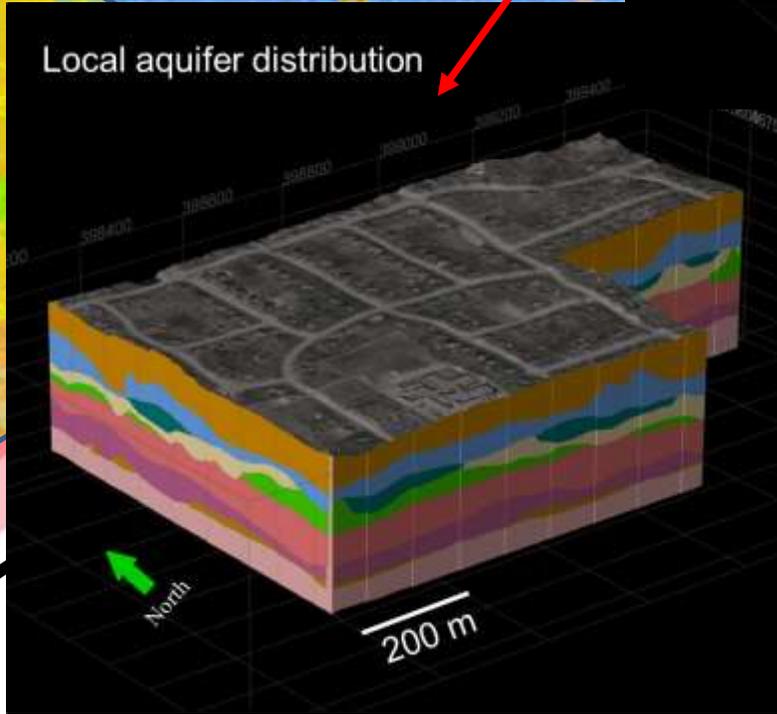
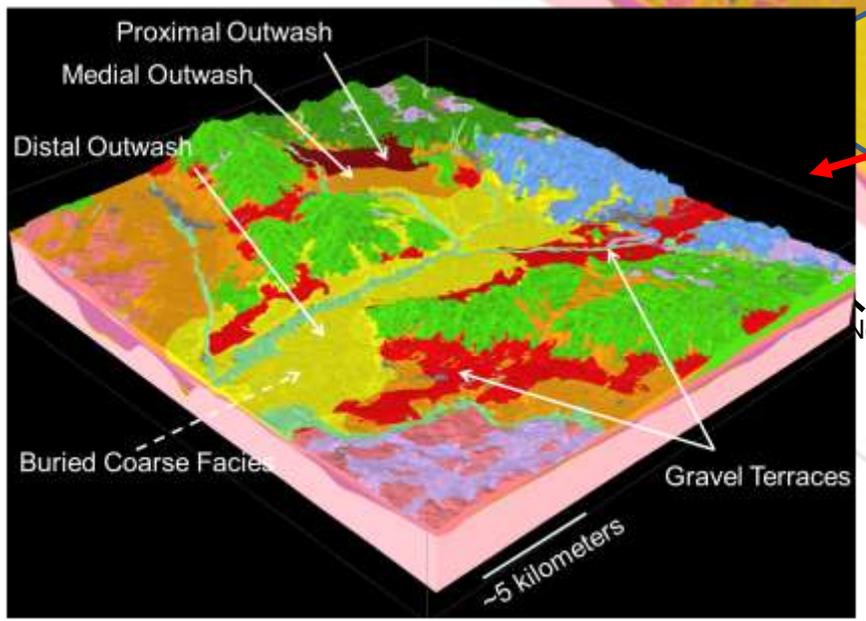
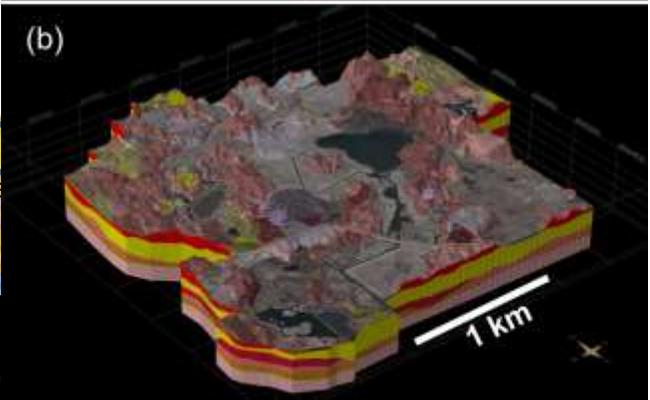
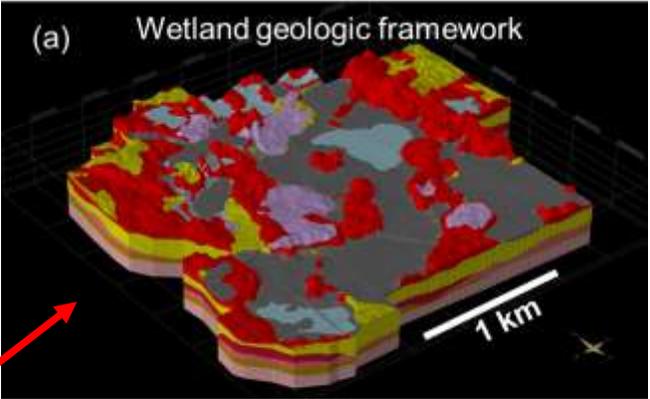
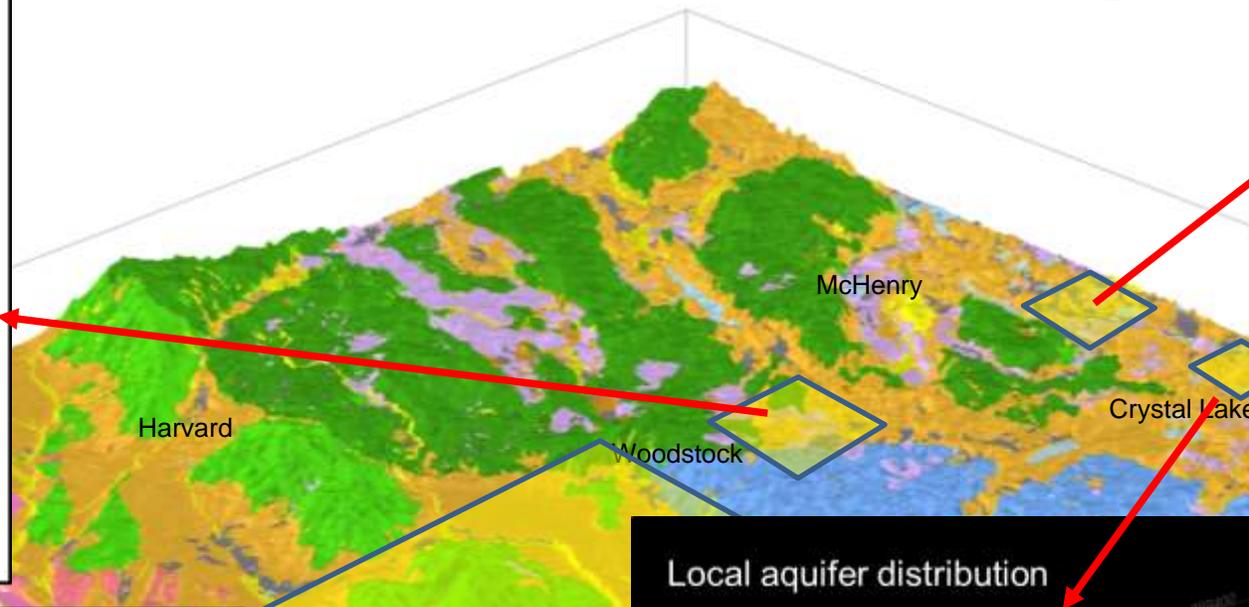
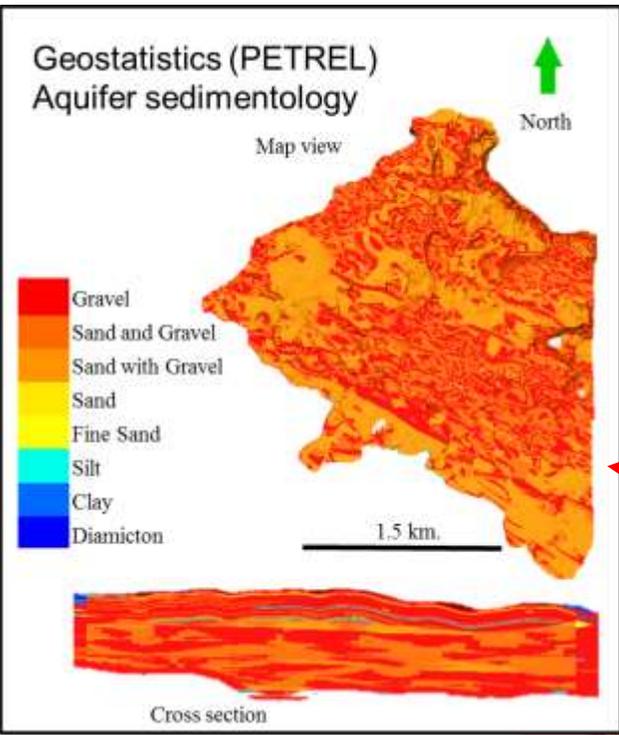
# Multiscale 3D Mapping



# Multiscale 3D Mapping



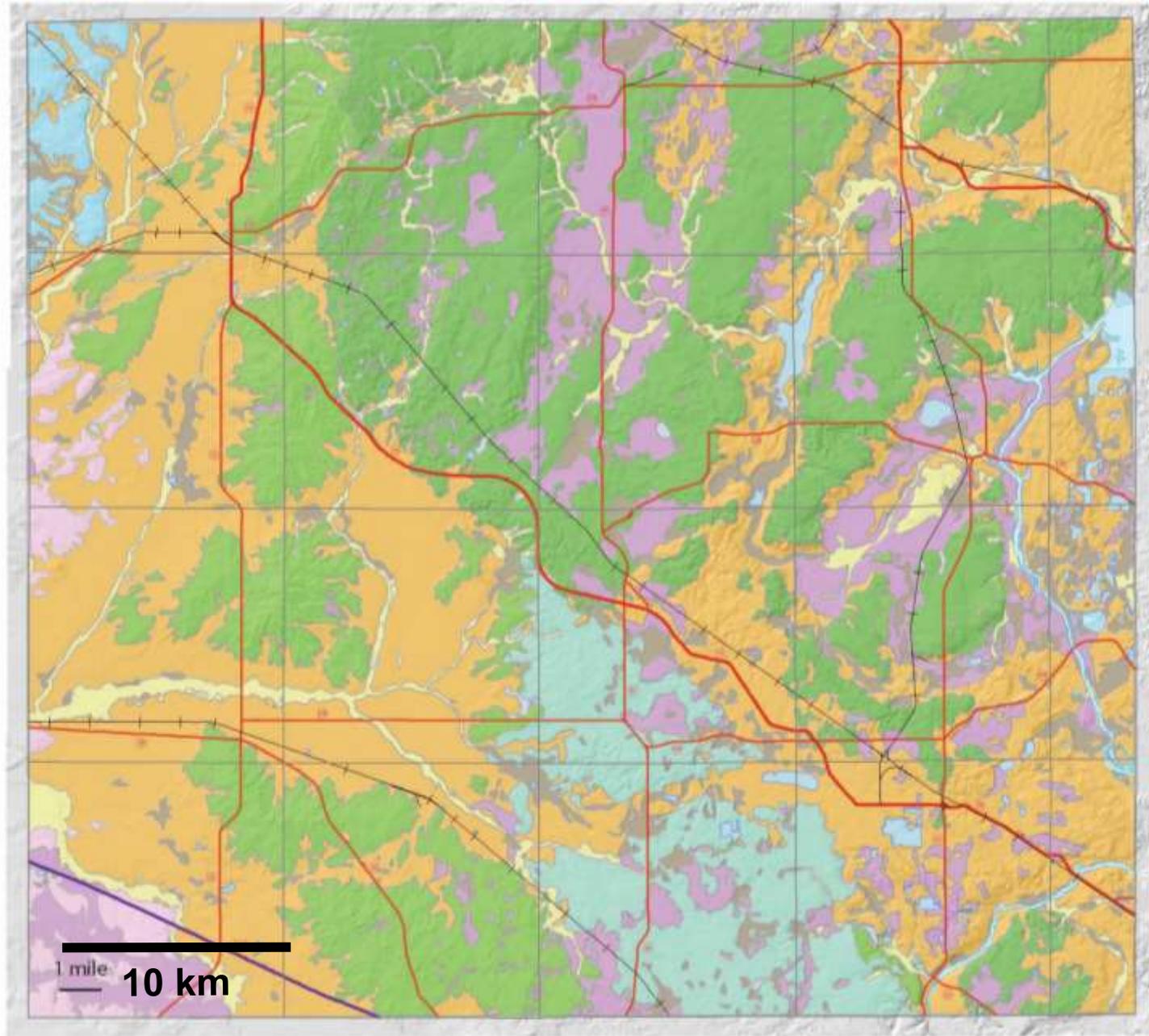
# Multiscale 3D Mapping



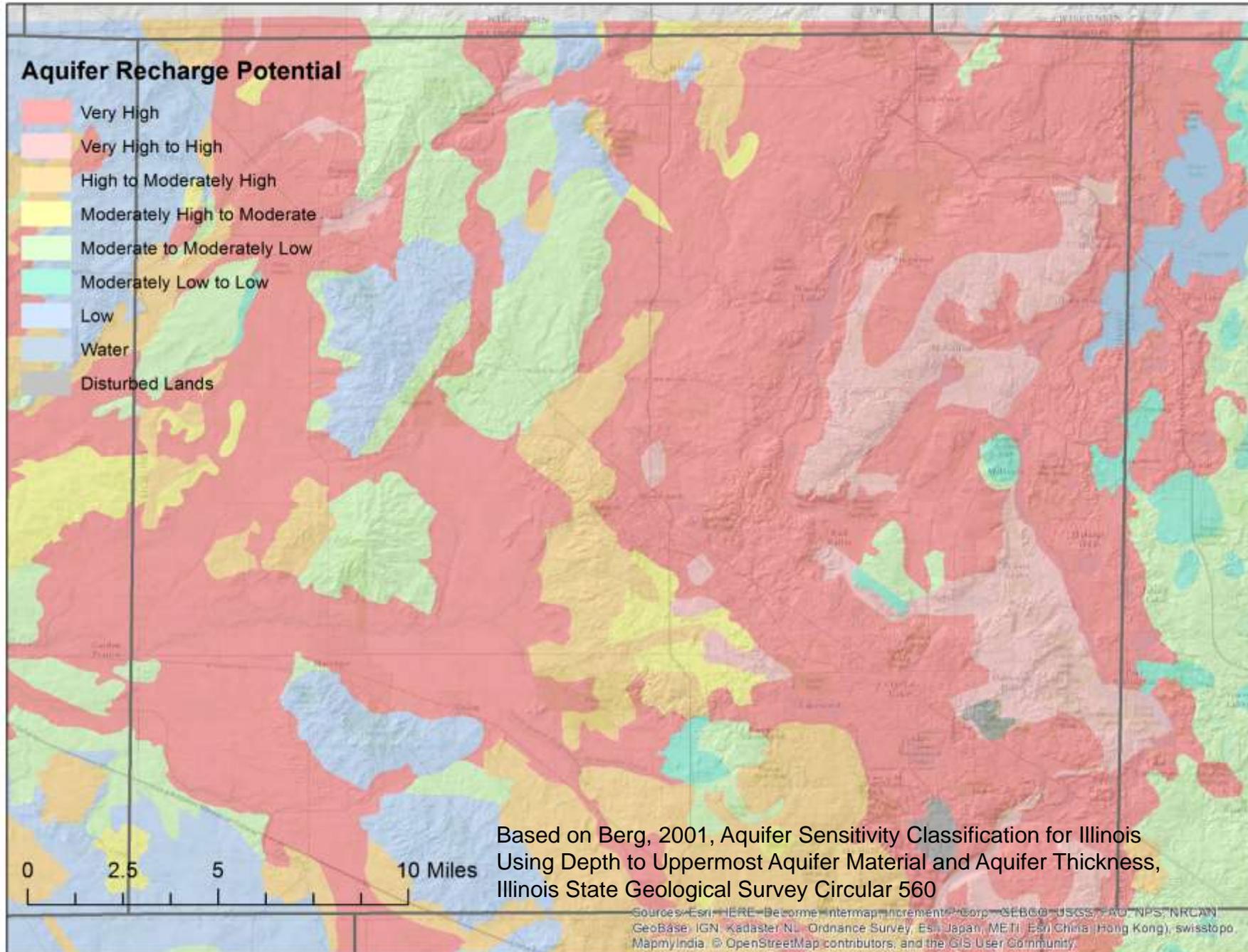
# Applications of 3-D Geologic Information in McHenry County

- Revised ***contamination potential*** maps and new planning tools
- Predictive flow modeling for ***long-term water supply***
- Modeling impacts of ***irrigation wells***
- Siting new ***water supply well(s)***
- ***VOC contamination*** site
- Assessing changes in water levels of ***recreational lake(s)***

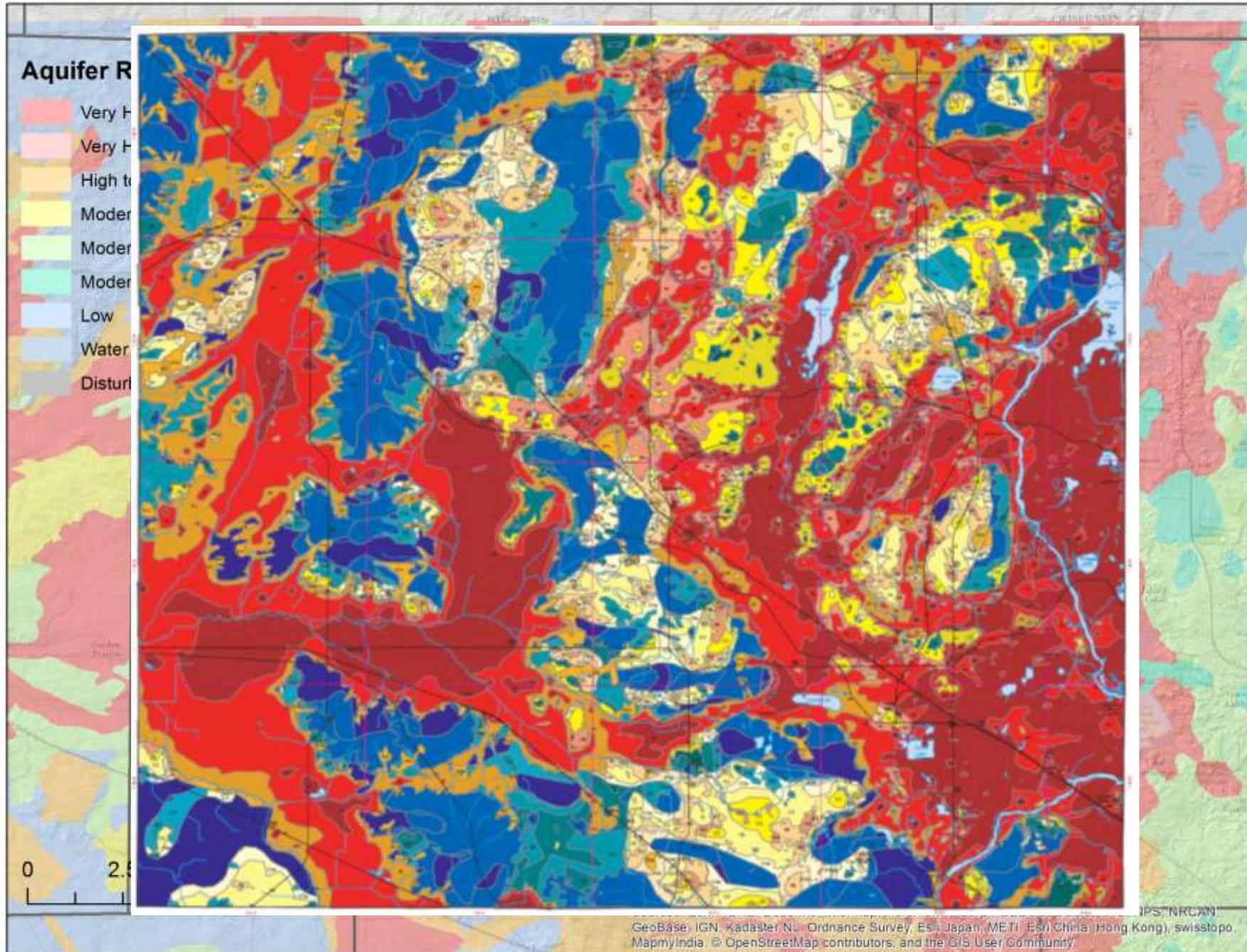
# Contamination Potential and Sensitive Aquifer Recharge Area (SARA) Map



# Contamination Potential and Sensitive Aquifer Recharge Area (SARA) Map



# Contamination Potential and Sensitive Aquifer Recharge Area (SARA) Map

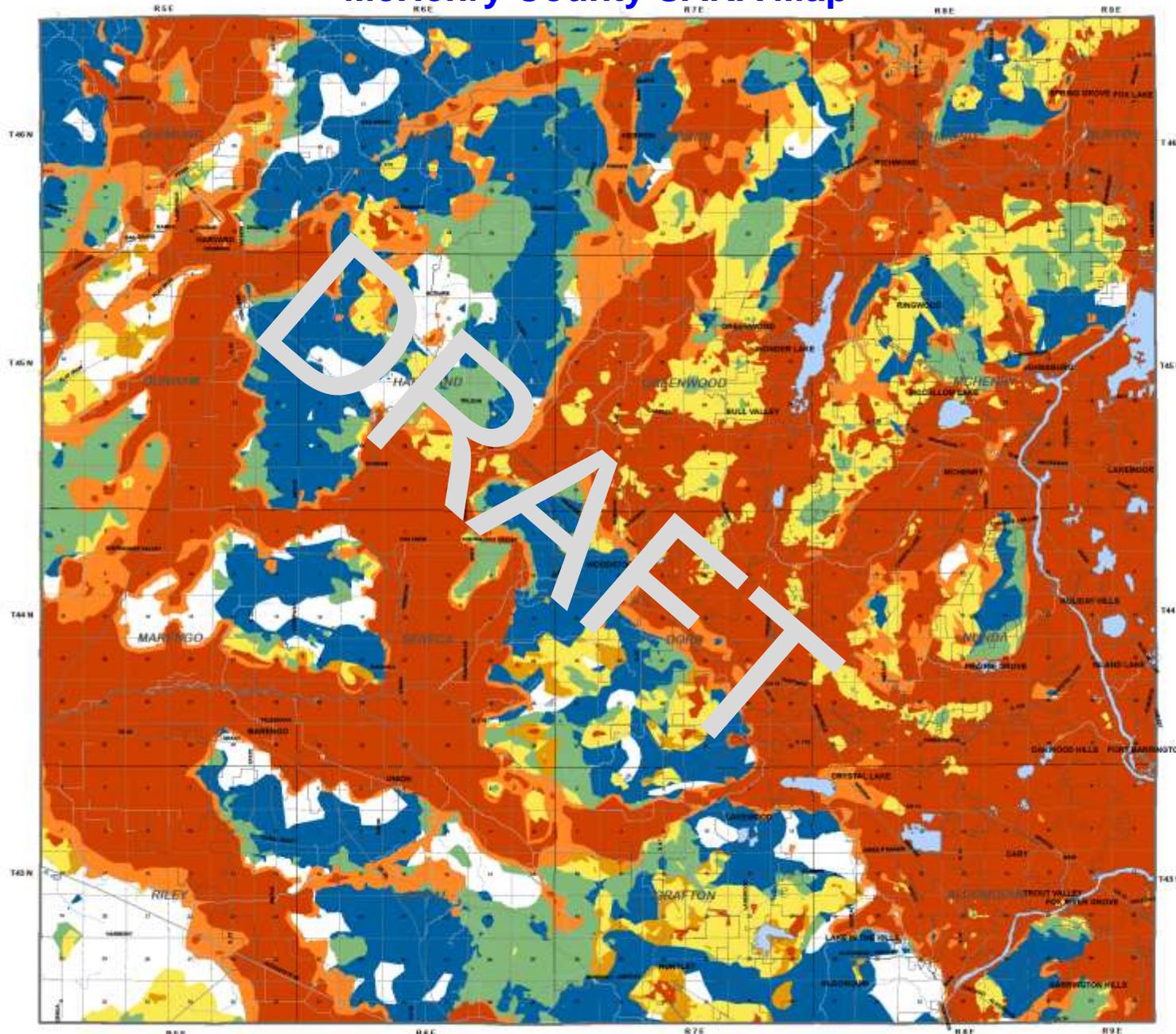


# Contamination Potential and Sensitive Aquifer Recharge Area (SARA) Map

## McHenry County SARA Map



### MCHENRY COUNTY SENSITIVE AQUIFER RECHARGE AREAS



- HIGH POTENTIAL FOR AQUIFER CONTAMINATION**
  - A1 > 50 feet thick within 5 feet of the land surface
  - A2 > 50 feet thick between 5 and 20 feet below the land surface
  - A3 20 to 50 feet thick between within 5 feet of the land surface
  - A4 20 to 50 feet thick between 5 and 20 feet below the land surface
- MODERATELY HIGH POTENTIAL FOR AQUIFER CONTAMINATION**
  - B1 5 to 20 feet thick between within 5 feet of the land surface
  - B2 5 to 20 feet thick between 5 and 20 feet below the land surface
- MODERATE POTENTIAL FOR AQUIFER CONTAMINATION**
  - C1 > 50 feet thick between 20 and 50 feet below the land surface
  - C2 20 to 50 feet thick between 20 and 50 feet below the land surface
  - C3 5 to 20 feet thick between 20 and 50 feet below the land surface
- MODERATELY LOW POTENTIAL FOR AQUIFER CONTAMINATION**
  - D1 > 50 feet thick between 50 and 100 feet below the land surface
  - D2 20 to 50 feet thick between 50 and 100 feet below the land surface
  - D3 20 to 50 feet thick between 50 and 100 feet below the land surface
- LOW POTENTIAL FOR AQUIFER CONTAMINATION**
  - E1 >100 feet below the land surface
- Lakes, Rivers, Streams

#### TOWNSHIPS

CHEMUNG	ALDEN	HEBRON	RICHMOND	BURTON
DUNHAM	HARTLAND	GREENWOOD	MCHENRY	
MARENGO	SENECA	DORIS	MUNDA	
RILEY	CORAL	GRAFTON	ALGONGQUIN	

0 1 2 4 6 8

# Geologic and Hydrogeologic Modeling

## Three-dimensional Geologic Mapping for McHenry County

Jason F. Thomason and Donald A. Keefer

Illinois State Geological Survey  
Prairie Research Institute  
University of Illinois at Urbana-Champaign

November, 2013



Contract Report 2013-06

## Groundwater Simulation Modeling and Potentiometric Surface Mapping, McHenry County, Illinois

Scott C. Meyer, Yu-Feng Lin, Daniel B. Abrams, George S. Roadcap

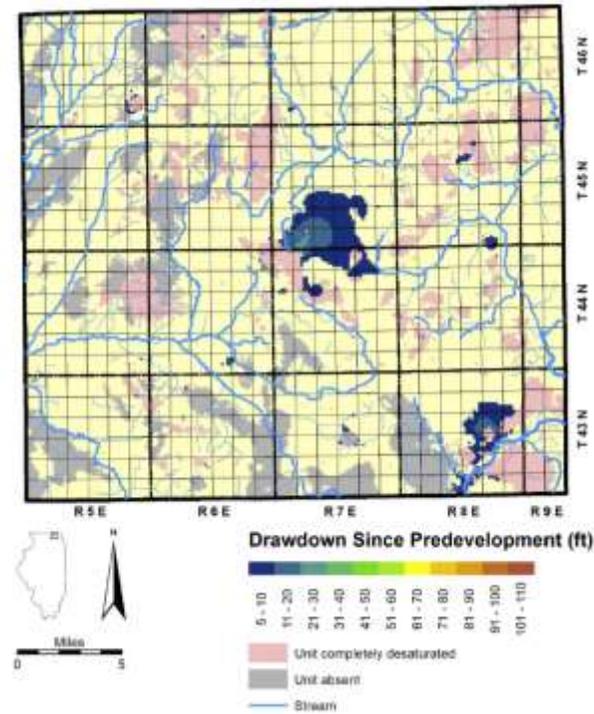
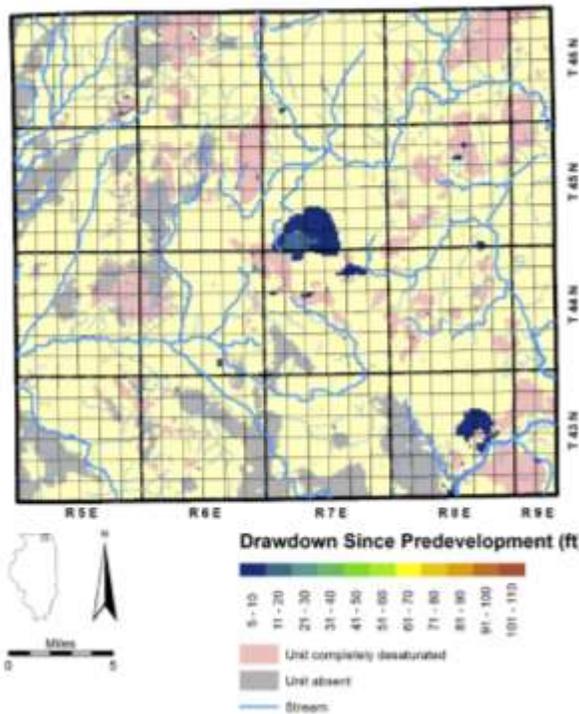
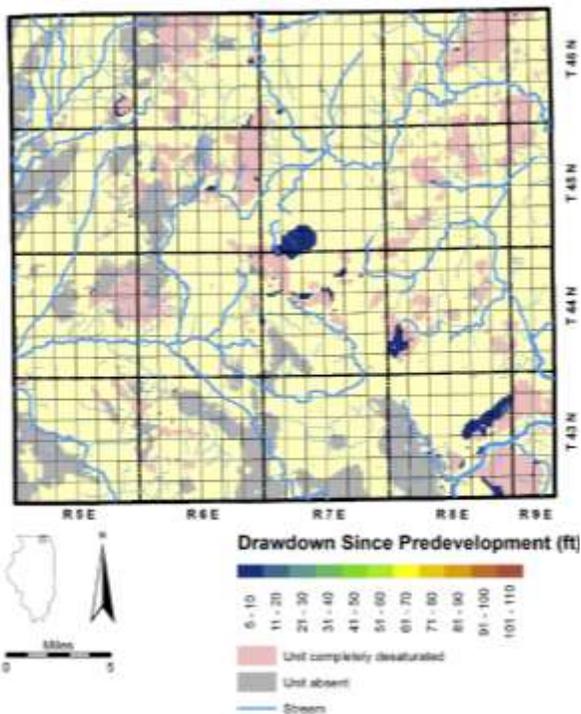
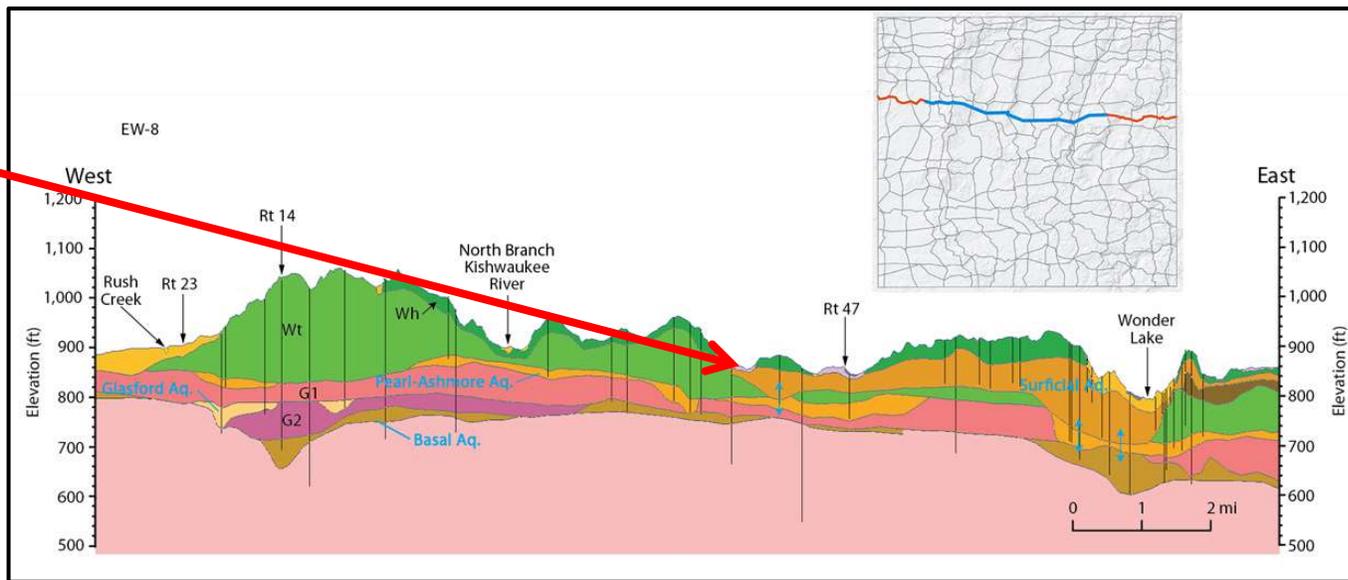


ILLINOIS

# Haeger-Beverly Aquifer

## Simulated Drawdown 2009, 2030, & 2050

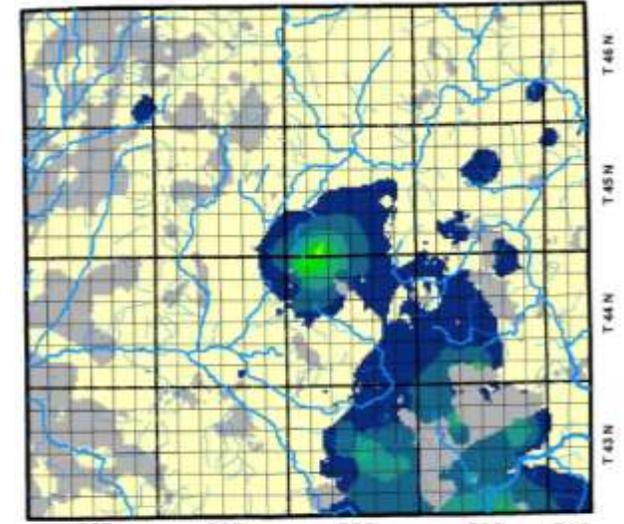
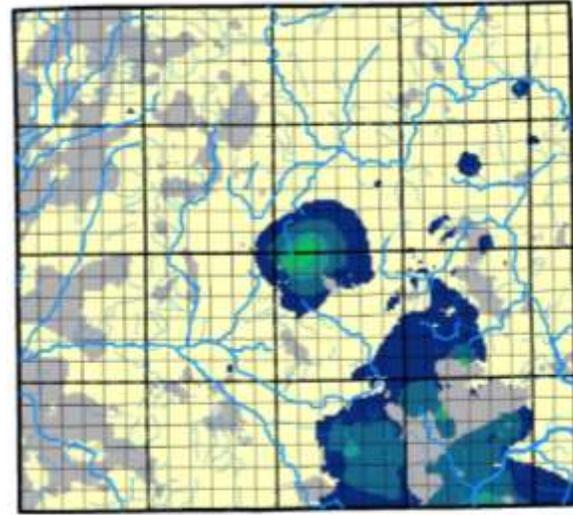
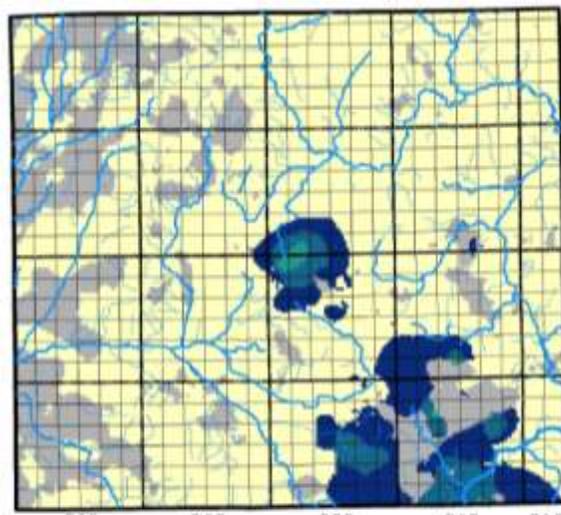
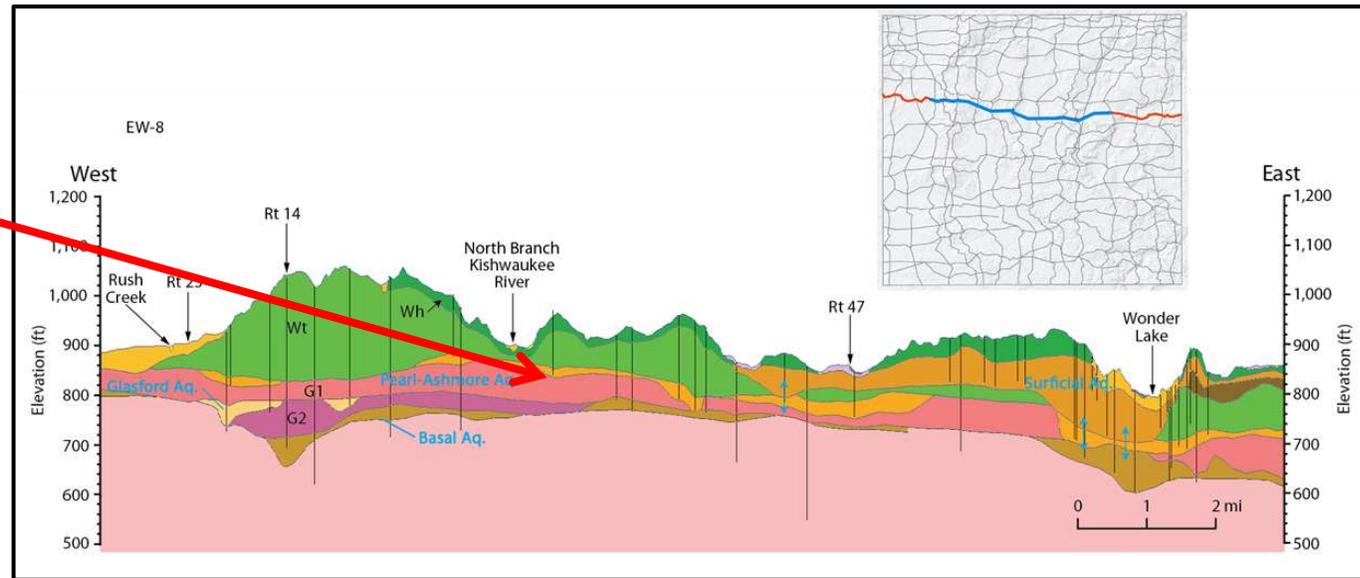
Illinois State Water Survey  
Meyer, et al., 2013



# Ashmore Aquifer

Simulated  
Drawdown  
2009, 2030, & 2050

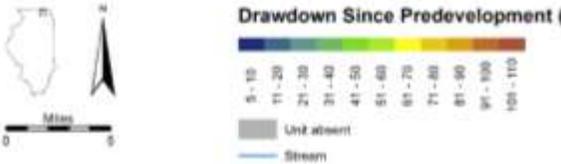
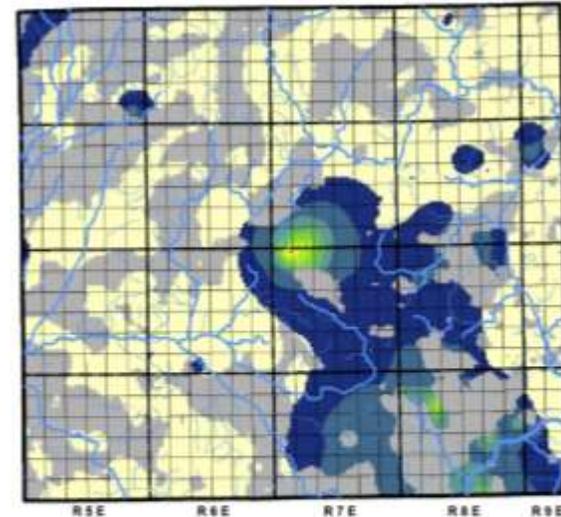
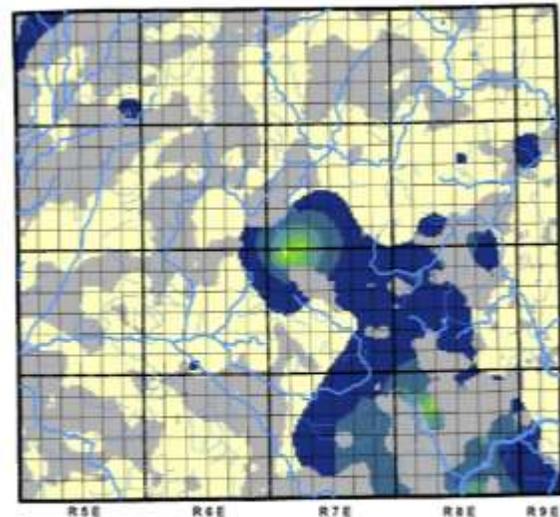
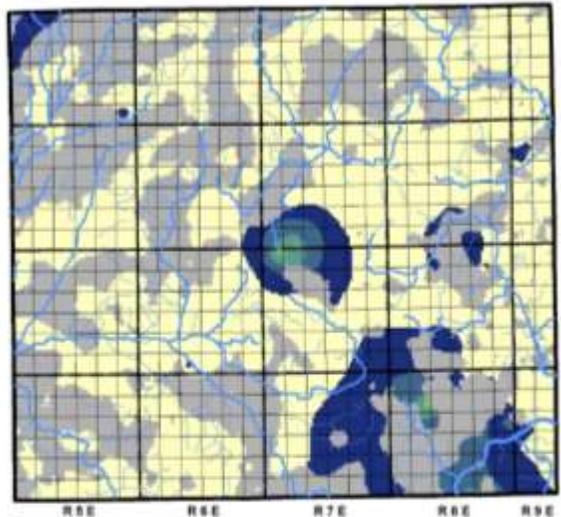
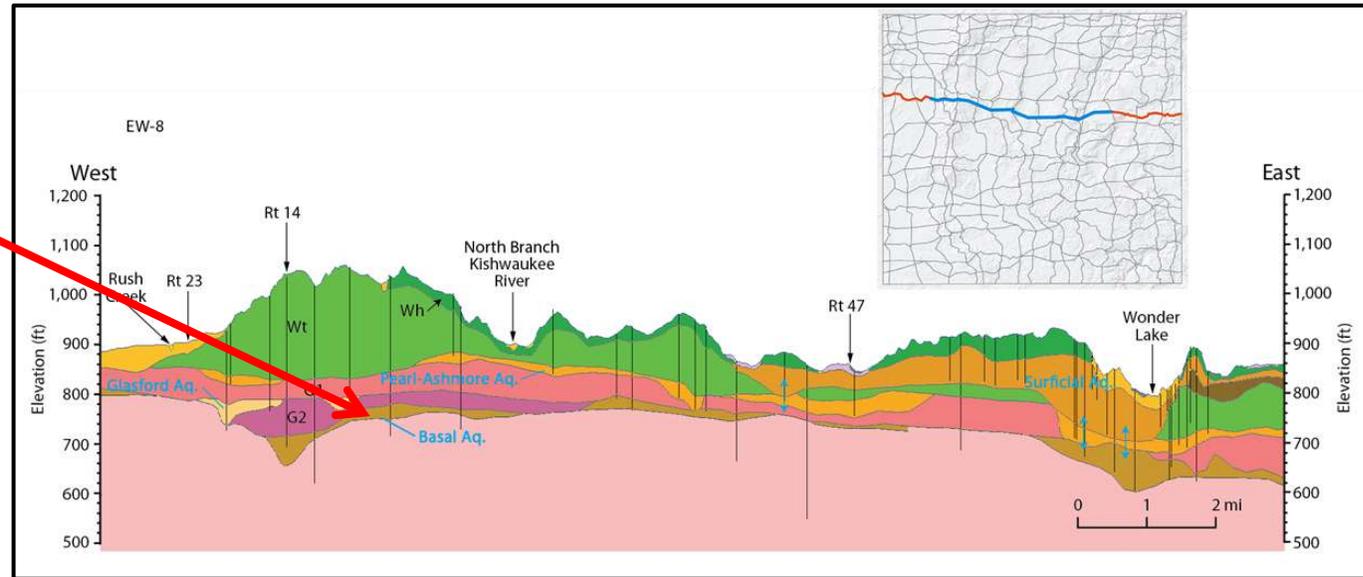
Illinois State  
Water Survey  
Meyer, et al., 2013



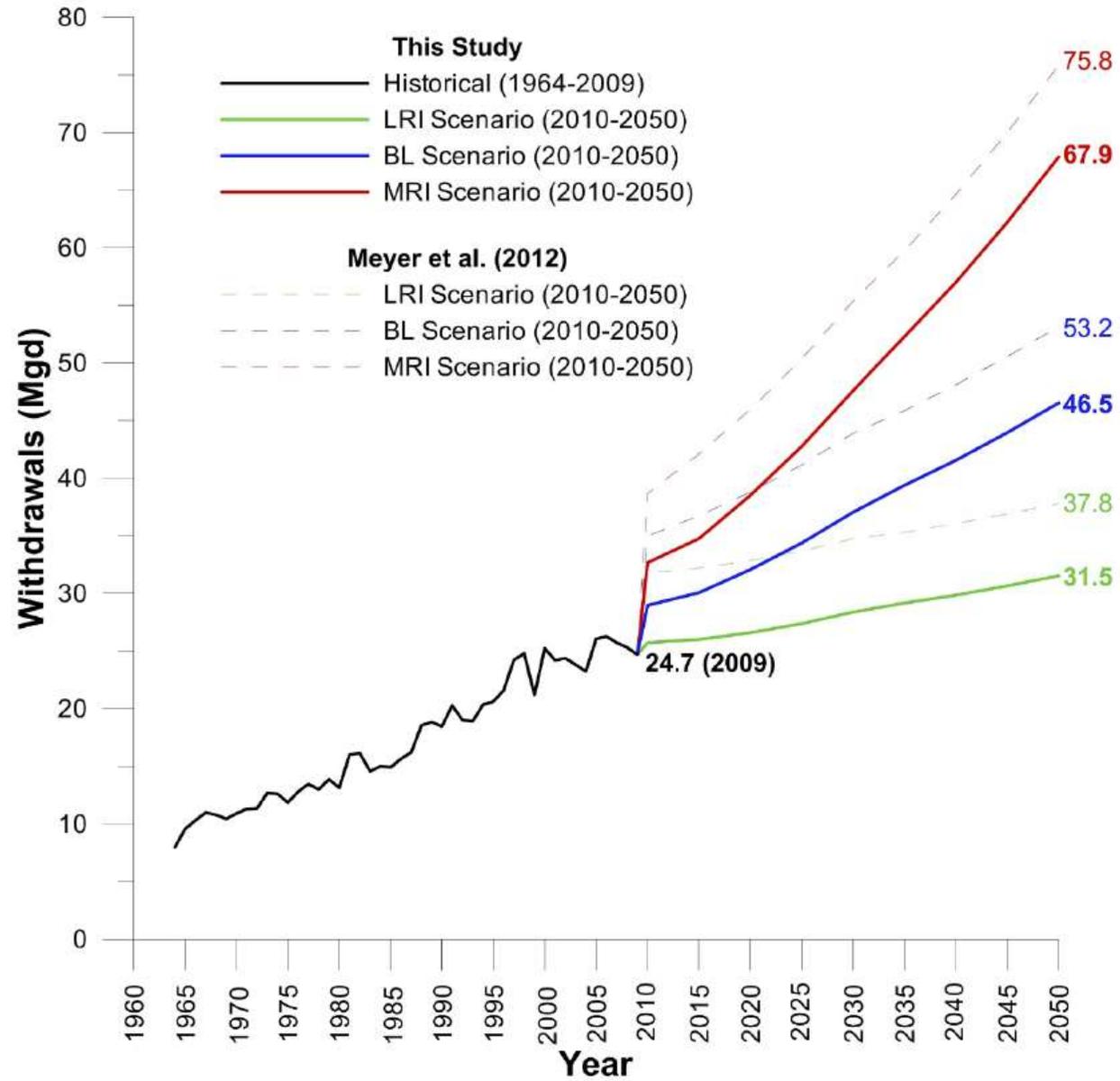
# Lower Glasford Aquifer

Simulated Drawdown 2009, 2030, & 2050

Illinois State Water Survey  
Meyer, et al., 2013

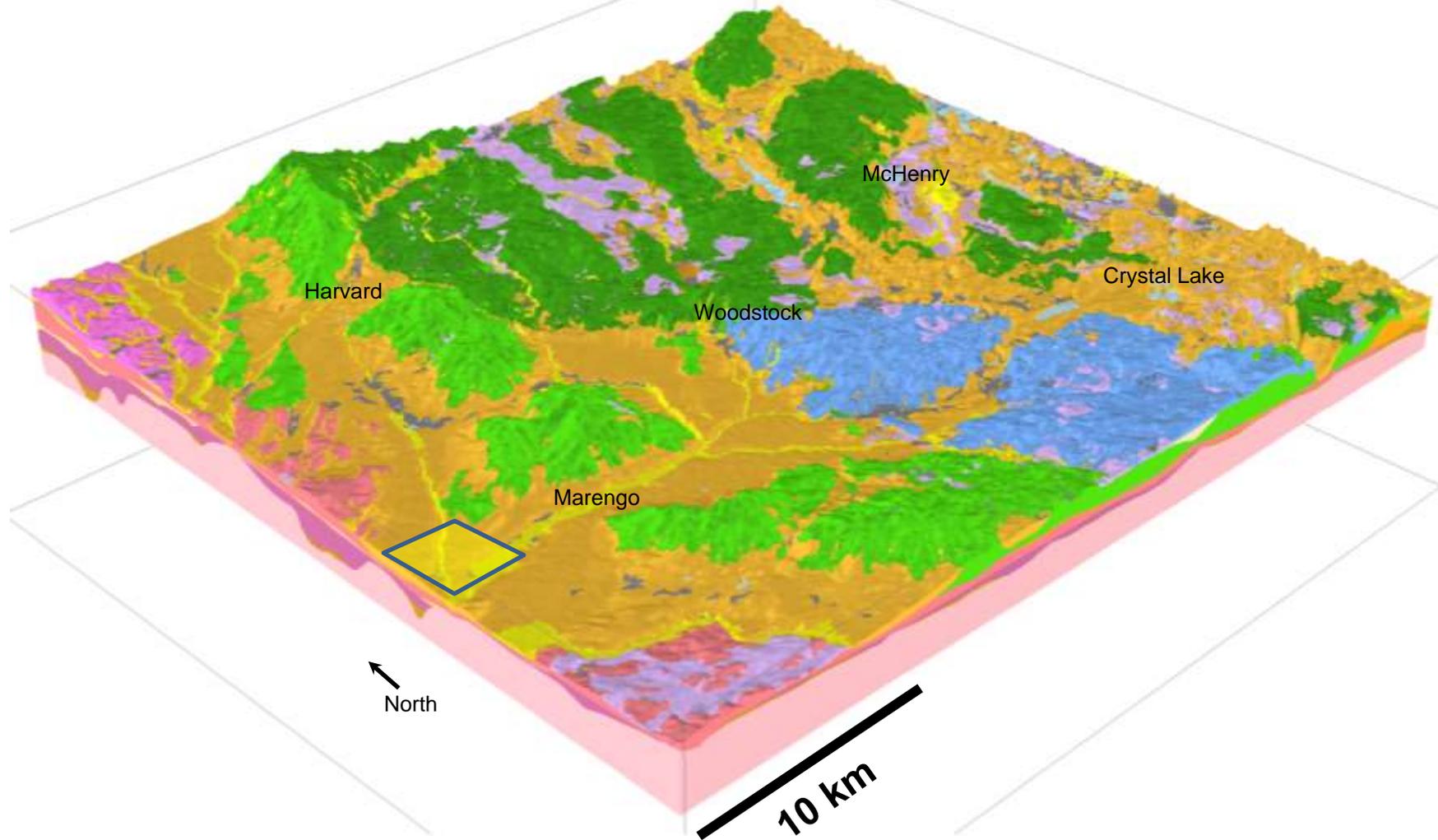


**Illinois State  
Water Survey  
Meyer, et al., 2013**



# Impacts and Applications

Capture-zone modeling of irrigation wells



# Capture zone modeling of irrigation wells

Journal of Geoscience and Environment Protection, 2016, 4, 43-53  
Published Online May 2016 in SciRes. <http://www.scirp.org/journal/gep>  
<http://dx.doi.org/10.4236/gep.2016.45005>



## Role of Multiple High-Capacity Irrigation Wells on a Surficial Sand and Gravel Aquifer

Logan C. Seipel<sup>1,2</sup>, Eric W. Peterson<sup>2\*</sup>, David H. Malone<sup>2</sup>, Jason F. Thomason<sup>3</sup>

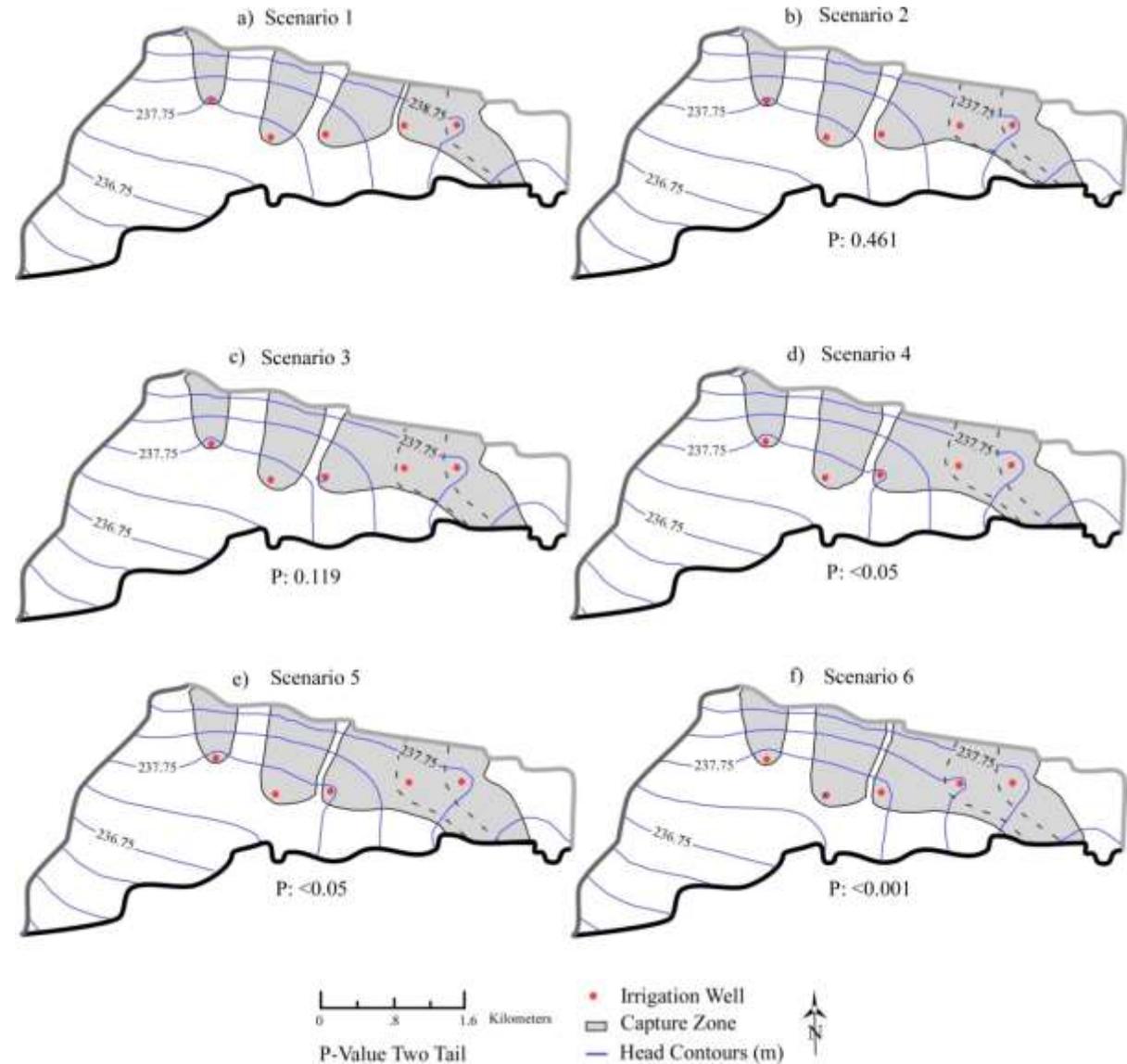
<sup>1</sup>Braun Intertec Corporation, Minneapolis, MN, USA

<sup>2</sup>Department Geography-Geology, Illinois State University, Normal, IL, USA

<sup>3</sup>Illinois State Geological Survey, Champaign, IL, USA

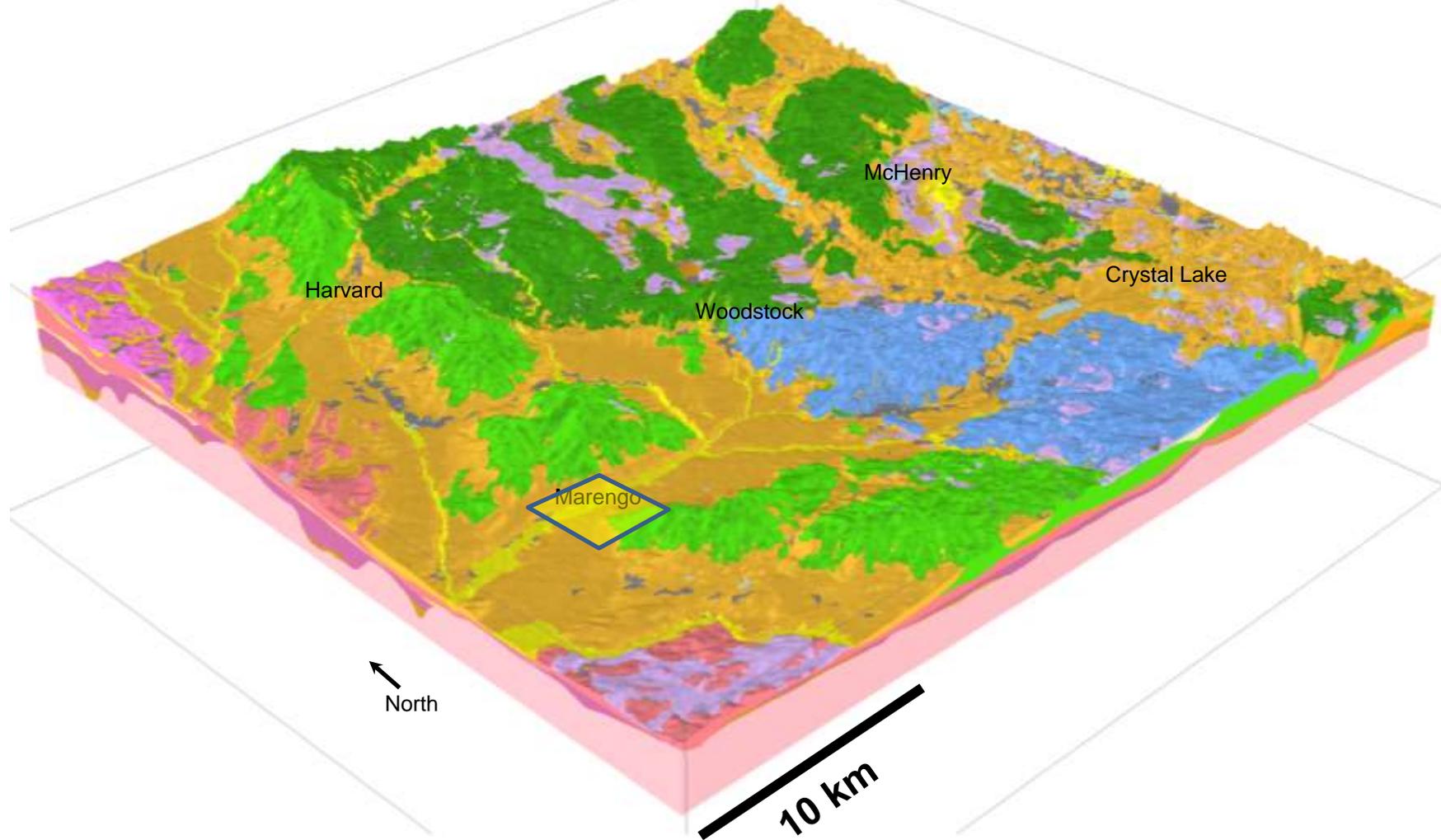
Email: <sup>\*</sup>ewpeter@ilstu.edu

Received 1 April 2016; accepted 3 May 2016; published 6 May 2016



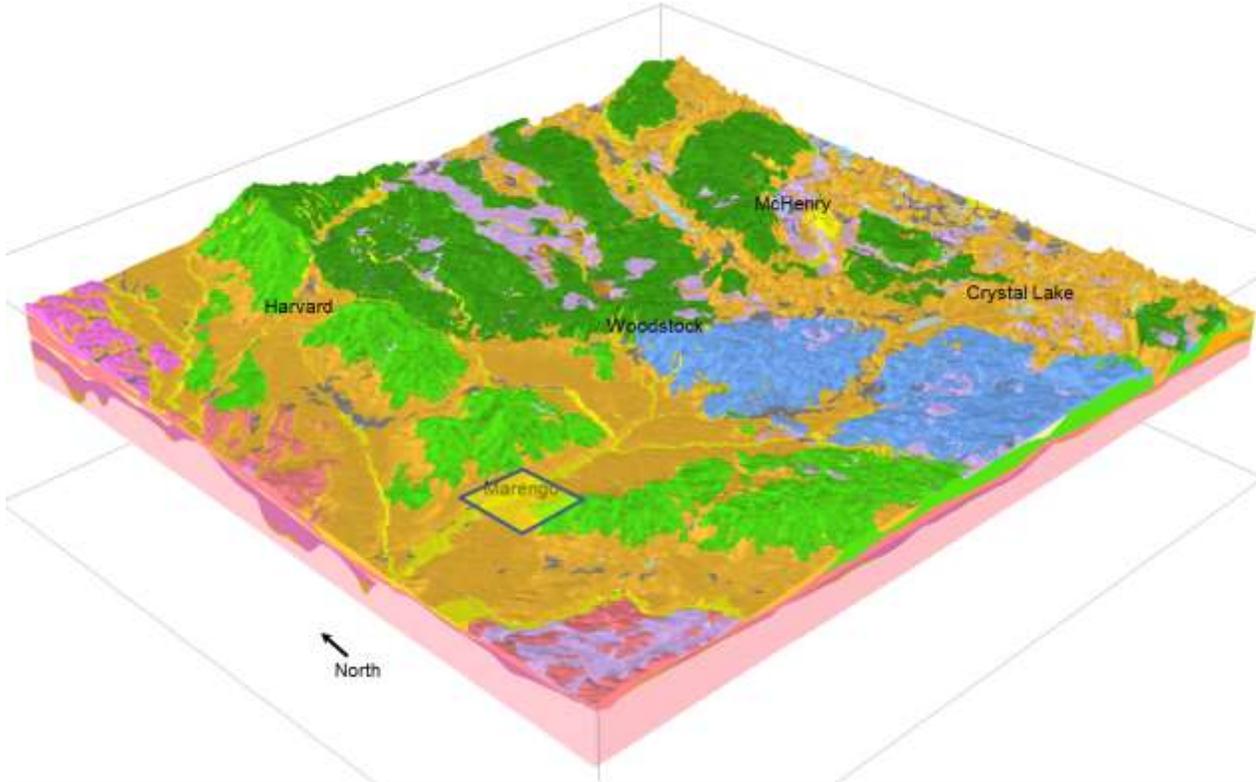
# Impacts and Applications

## Marengo Water Supply



# Impacts and Applications

## Marengo Water Supply



SECTIONS

NORTHWEST HERALD

LOCAL

## Marengo finds new water supply

By STEPHEN DI BENEDETTO - sdibenedetto@shawmedia.com

MARENGO – A newly discovered water supply on Marengo's west side could broaden the city's expansion plans by helping it recruit industrial companies, City Manager Gary Boden said.

HR Green, a planning firm contacted by the city, discovered the large, shallow aquifer as city administrators were looking to replace a malfunctioning well on the east side of town.

Industries that rely on water, such as food-processing plants, could find Marengo attractive, Boden said.

"Our position is evolving. Our development is going to be a little bit more diversified. We are going to look at industrial, as well as commercial and residential," he said.

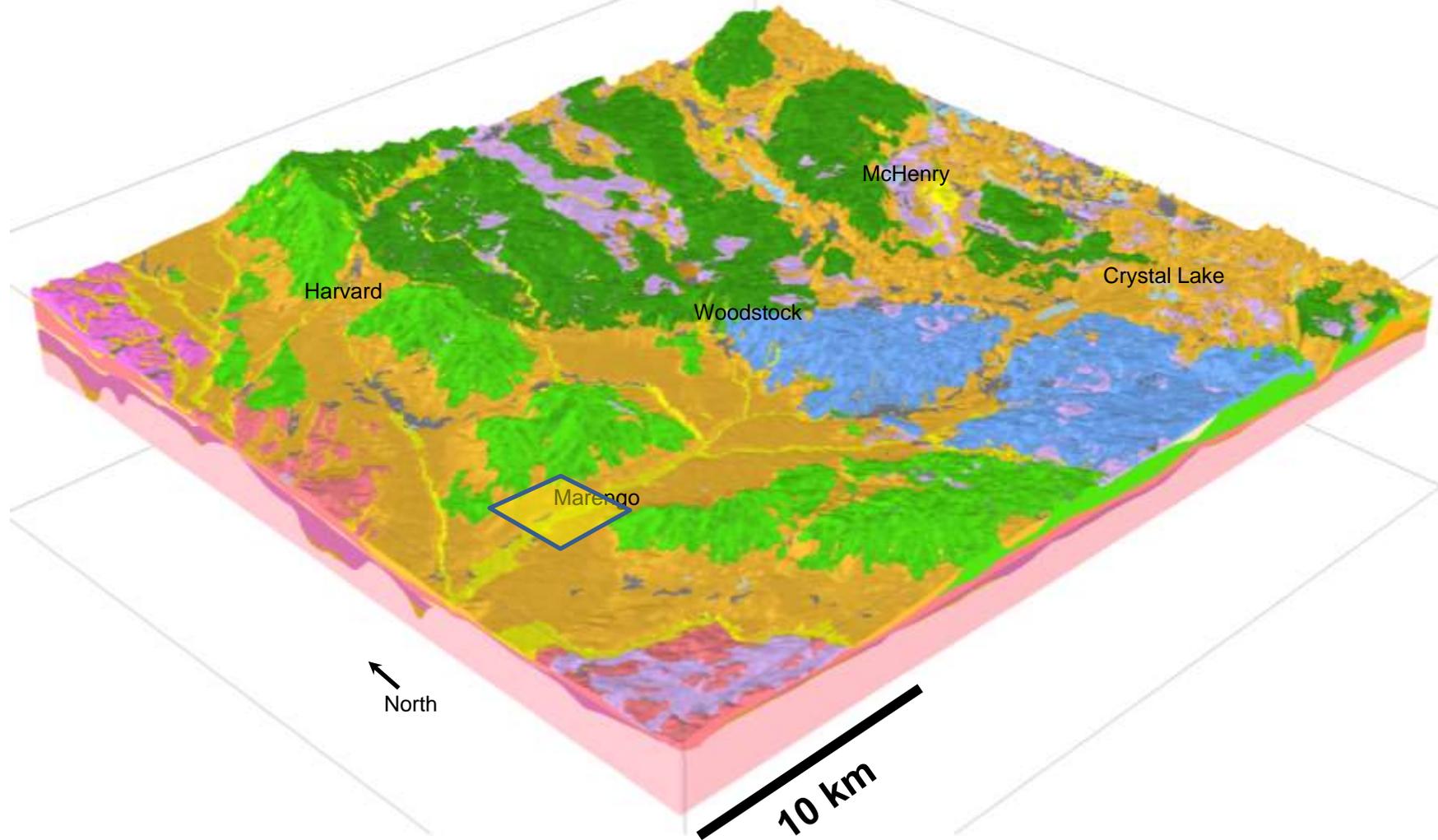
Marengo recently revealed a plan to expand the city to the south and west. It hinges on the city's ability to court the Illinois State Toll Highway Authority and get an interchange at Route 23 and Interstate 90. Officials have been talking with the state agency and others, much as Huntley did to secure its full interchange under construction at Route 47 and I-90.

The new water supply is so plentiful that officials are contemplating selling water to other communities and using it for Marengo's system, Boden said.

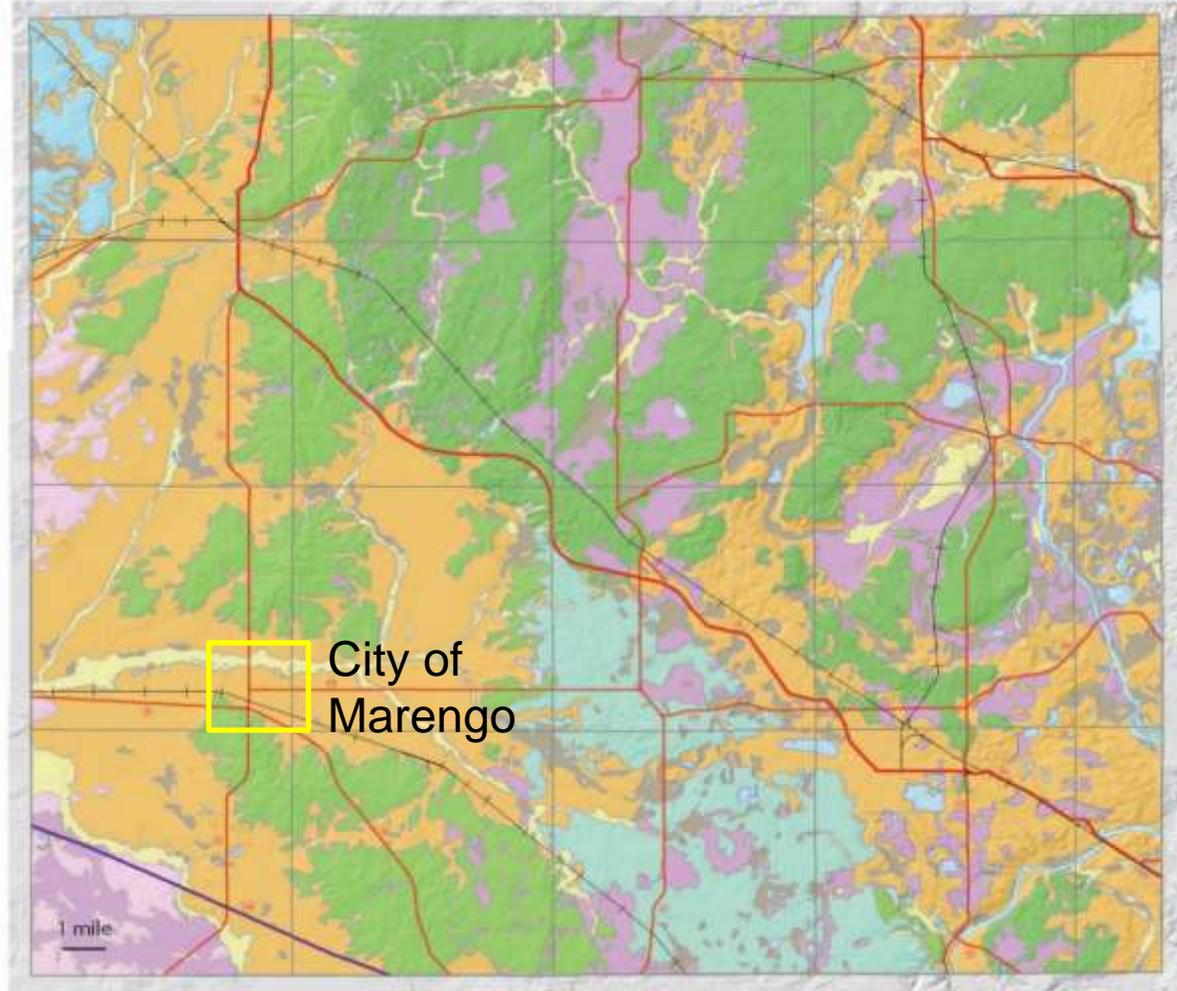
Marengo's current water supply has been an asset during the summer drought. Residents have had unrestricted water use, while neighboring communities limited usage.

# Impacts and Applications

Volatile organic compound (VOC) contamination site



## Volatile organic compound (VOC) contamination site



# Volatile organic compound (VOC) contamination site



## NEWS

RELEASE

September 9, 2010

### State Health Department Recommends Water Well Testing for Private Wells Near Marengo

**SPRINGFIELD, Ill.** - The Illinois Department of Public Health (IDPH) is advising residents who obtain their drinking water from private wells in the Marengo (McHenry County) area to test their water for possible groundwater contamination. Routine testing of Marengo's community water supply wells by the Illinois Environmental Protection Agency (IEPA) indicates contaminants could be present in the area's private wells.

The contaminants benzene and methyl tert-butyl ether (MTBE) were detected at levels lower than the Illinois Groundwater Standard. Although the contaminants' levels were lower than the standard, this is the same groundwater that serves private wells and it is possible the levels of the contaminants may be higher in private wells.

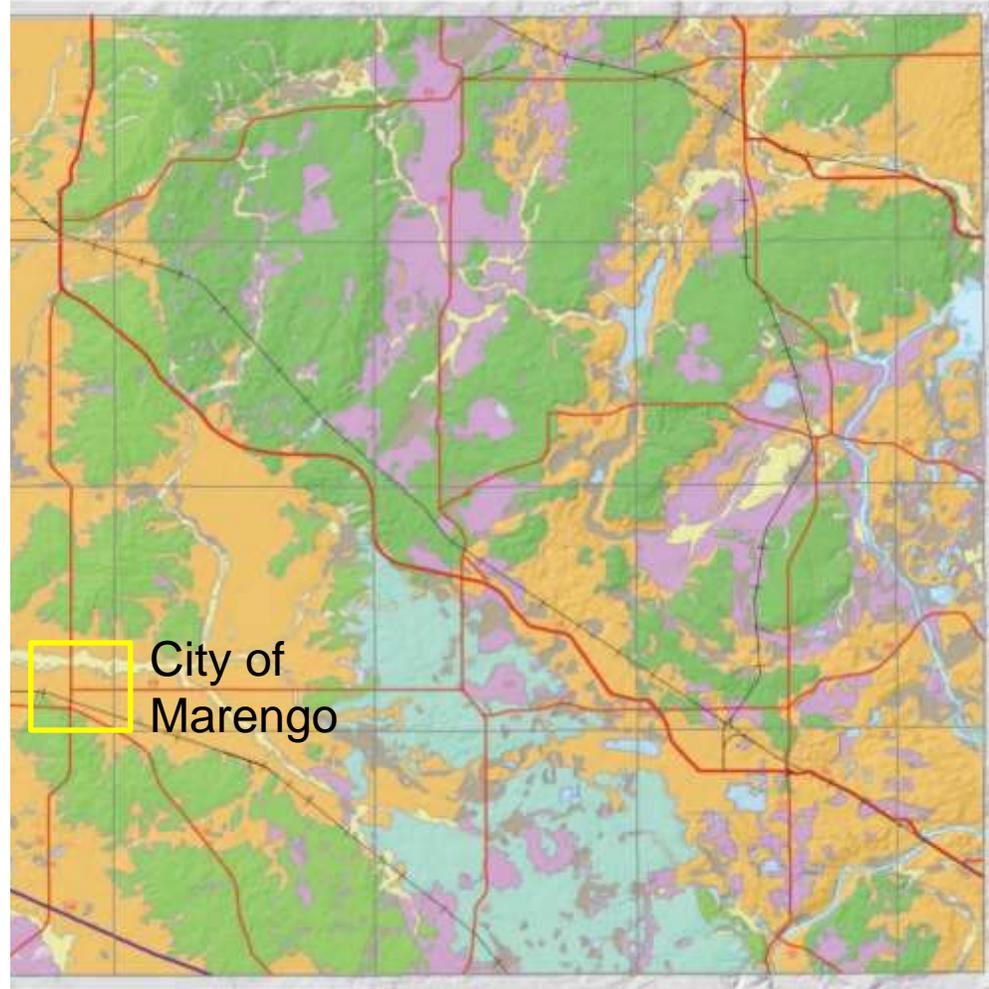
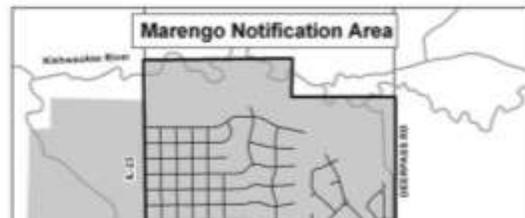
Residents with private wells located within the area (map below) north of U.S. 20, east of Illinois 23, south of the Kishwaukee River, and west of the Marengo eastern city limits are encouraged to have their water tested for volatile organic compounds by a private laboratory.

For a list of laboratories certified to analyze drinking water for volatile organic compounds, interpretation of test results, contaminant health effects information, and recommendations for individuals who regularly consume well water, contact Joe O'Connor, IDPH West Chicago Regional Office, 245 West Roosevelt Road, Bldg 5, West Chicago, IL 60185, phone (630) 293-6800 or [joe.o'connor@illinois.gov](mailto:joe.o'connor@illinois.gov).

The risk of adverse health effects depends on the levels of contaminants in the water and the length of exposure. Long-term exposure to these chemicals may result in an increased health risk to the liver and kidneys.

No violations of State of Illinois or federal drinking water standards have occurred in Marengo's community water supply. For information concerning the community water supply contact Dean Studer at 217-558-8280 or via email at [dean.studer@illinois.gov](mailto:dean.studer@illinois.gov).

This information has been compiled from historic data and is provided to the public to ensure full disclosure of state records.



City of  
Marengo

# Volatile organic compound (VOC) contamination site



## NEWS

RELEASE

September 9, 2010

### State Health Department Recommends Water Well Testing for Private Wells Near Marengo

**SPRINGFIELD, Ill.** - The Illinois Department of Public Health (IDPH) is advising residents who obtain their drinking water from private wells in the Marengo (McHenry County) area to test their water for possible groundwater contamination. Routine testing of Marengo's community water supply wells by the Illinois Environmental Protection Agency (IEPA) indicates contaminants could be present in the area's private wells.

The contaminants benzene and methyl tert-butyl ether (MTBE) were detected at levels lower than the Illinois Groundwater Standard. Although the contaminants' levels were lower than the standard, this is the same groundwater that serves private wells and it is possible the levels of the contaminants may be higher in private wells.

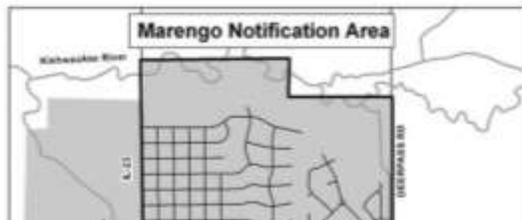
Residents with private wells located within the area (map below) north of U.S. 20, east of Illinois 23, south of the Kishwaukee River, and west of the Marengo eastern city limits are encouraged to have their water tested for volatile organic compounds by a private laboratory.

For a list of laboratories certified to analyze drinking water for volatile organic compounds, interpretation of test results, contaminant health effects information, and recommendations for individuals who regularly consume well water, contact Joe O'Connor, IDPH West Chicago Regional Office, 245 West Roosevelt Road, Bldg 5, West Chicago, IL 60185, phone (630) 293-6800 or [joe.oconnor@illinois.gov](mailto:joe.oconnor@illinois.gov).

The risk of adverse health effects depends on the levels of contaminants in the water and the length of exposure. Long-term exposure to these chemicals may result in an increased health risk to the liver and kidneys.

No violations of State of Illinois or federal drinking water standards have occurred in Marengo's community water supply. For information concerning the community water supply contact Dean Studer at 217-558-8280 or via email at [dean.studer@illinois.gov](mailto:dean.studer@illinois.gov).

This information has been compiled from historic data and is provided to the public to ensure full disclosure of state records.



## The Marengo-Union Times

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### News

#### Six Private Wells Contaminated

July 02, 2013

By Staff

In a press release on June 14, Attorney General Lisa Madigan's office stated that it had "obtained a court order to ensure that several Marengo, Ill. residents with private wells have immediate access to safe drinking water."

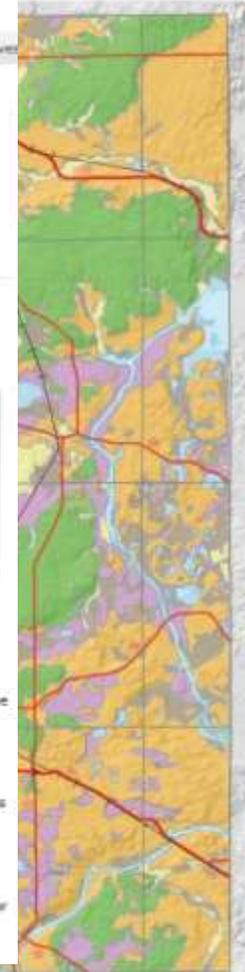


"Recent tests indicate that elevated levels of cancer-causing agents, including trichloroethylene (TCE) and vinyl chloride, were present in area groundwater near the Arnold Magnetic Technologies Corporation at 300 N. West Street," the statement continued. "According to the Illinois Environmental Protection Agency (IEPA), Arnold previously used chlorinated solvents in its production process at a building located at the northwestern corner of the site."

"The order, entered in McHenry County Circuit Court, requires that Arnold and the property's owner, 300 West LLC, provide drinking water to the owners of private water wells located at four Ritz Road and two Railroad Street addresses in Marengo," the statement said. "The court specifically ordered the defendants to confirm arrangements with the six affected property owners to provide bottled water until the defendants receive written authorization from Madigan's office, and the IEPA, that they may cease distribution."

"Additionally, the court ordered the defendants to conduct water samples from 17 drinking water wells located on Ritz Road and Railroad Street in Marengo," the release also stated. "The tests will sample for a number of chemicals, including TCE and vinyl chloride that may have seeped into the nearby wells."

"This court order will ensure that the residents with private wells are supplied with safe drinking water by the defendants," Madigan said in the statement. "I strongly advise residents to use the bottled water until the all-clear signal is given that the wells are safe to use again."



# Volatile organic compound (VOC) contamination site



## NEWS

### RELEASE

September 9, 2010

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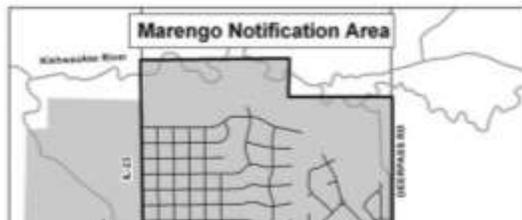
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July 02, 2012

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29°F  
Light Snow  
Full Moon

## NORTHWEST HERALD

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### Marengo water contamination settlement discussed at public meeting

Published: Thursday, July 5, 2012 11:22 a.m. CDT

By DACE BUCKLE [dbuckle@heraldmedia.com](mailto:dbuckle@heraldmedia.com)

**MARENGO** - The public met Thursday night to discuss terms of a proposed settlement for an ongoing dispute in Marengo involving contaminated groundwater.

Under the proposed terms of the settlement, the defendants - Arnold Engineering and 300 West - would be responsible for cleaning up the polluted groundwater and would provide filtration systems to some houses with wells that will use contaminated water during the cleanup process.

Several parties were on hand to provide public updates, including the Illinois Attorney General's Office, state Sen. Pam Althoff, B. McHenry, 300 West and Arnold Engineering, and many other public officials attended to hear the discussion.

"The point of this evening's meeting is to allow you to know what this proposal is and add your comments," Althoff said.

State Rep. Jack Franks, D-Marengo, also helped organize the meeting but couldn't be present because of important votes on the state budget in Springfield.

Kathryn Pamerter, who is handling the case for the Illinois Attorney General's Office, said her office has not decided whether it would accept the proposed settlement terms as they currently stand because they still are being evaluated by the Illinois Environmental Protection Agency.

However, public response to the meeting would be among the factors that would determine whether the settlement is accepted, she said.

"We understand your frustrations. Our goal here is to obtain a safe drinking water remedy and to get the groundwater contamination cleaned up at the site," Pamerter said.

Under the terms of the proposal, as relayed by 300 West attorney Howie Jablcki, the defendants would provide filtration systems to all properties that exceed IEPA standards for safe drinking water, currently limited to five Ritz Road homes and one on Railroad Road.

"We are taking full responsibility for the filtration systems - for their installation, for their maintenance and for their costs," Jablcki said. "Filtration would be in place until groundwater meets acceptable testing standards."

Other houses in the area, which currently receive bottled water from the defendants as part of an earlier court order, would not receive filtration systems unless future tests indicate the level of contaminants present exceeds acceptable IEPA standards.

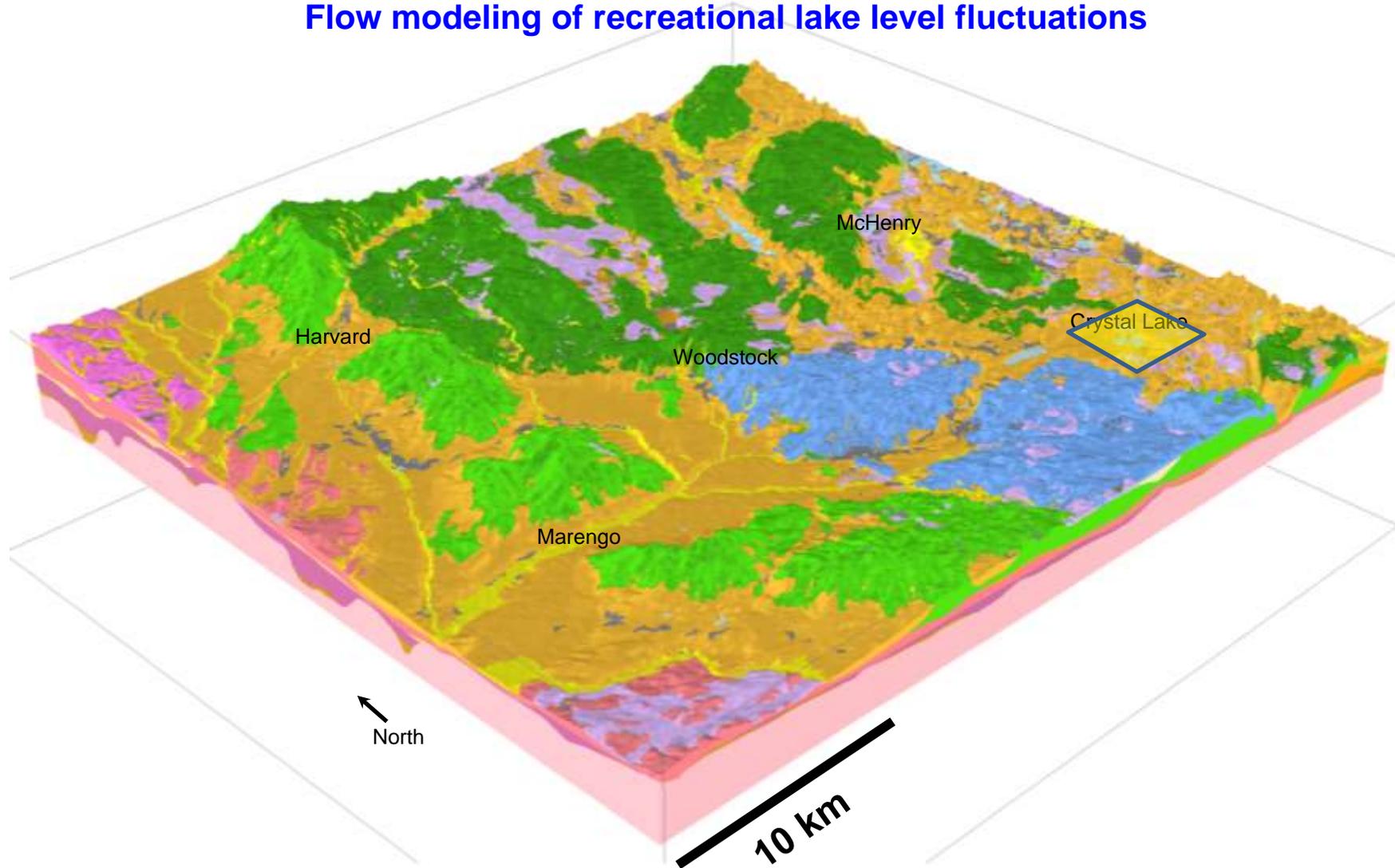
Many residents were opposed to the condition that contamination levels need to exceed IEPA standards before affected residents receive a filtration system.

"You've damaged our properties, and I think that the only way to take back that damage is to give every house in that area safe water, period," said Ritz Road resident Ann Anthony.

Previous Page | 1 | 2 | Next Page

# Impacts and Applications

Flow modeling of recreational lake level fluctuations



# Three-Oaks Recreation Area (TORA)



Figure 9. Map of computed groundwater levels in the upper sand and gravel aquifer from the TORA model showing the groundwater flow direction from northwest to southeast towards the Fox River. Measurements at USGS observation wells in May 2016 are shown in parentheses. Measured lake levels are displayed within the lakes boundaries. Contour interval is 5 feet.

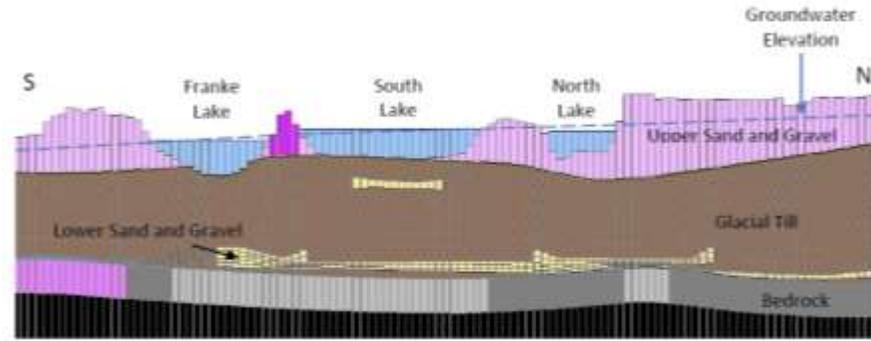


Figure 7. Cross-section of the TORA model from north to south depicting the quarry lakes and the underlying glacial material and bedrock. Lake cells were allowed to interact with the surrounding sand and gravel aquifer and receive precipitation. Lake levels were then calculated in the model.

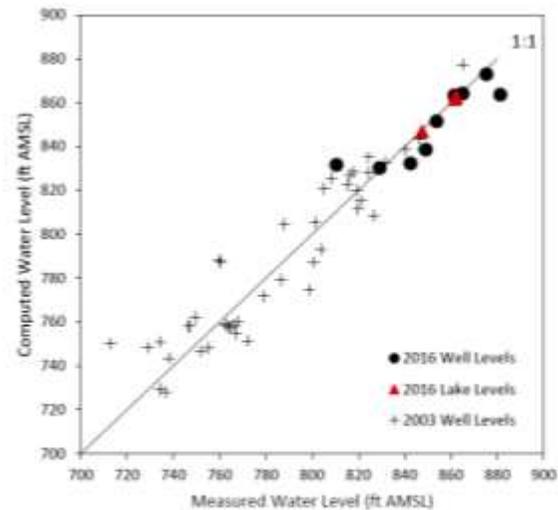


Figure 8. Plot of model computed water levels versus measured water levels. Computed water

from Hadley et. al., 2016, Illinois State Water Survey Contract Report to the City of Crystal Lake, Illinois

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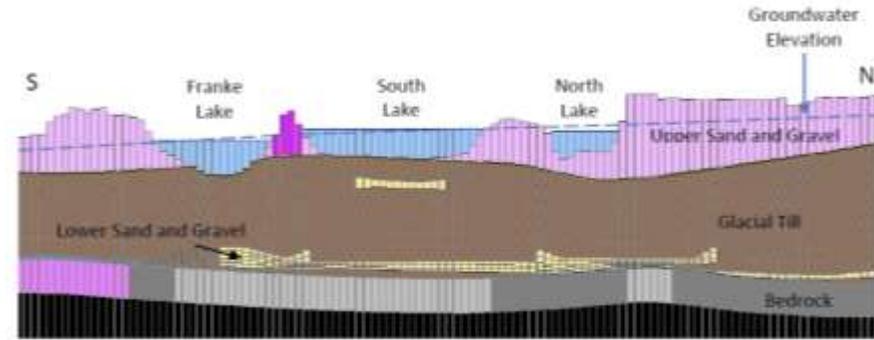


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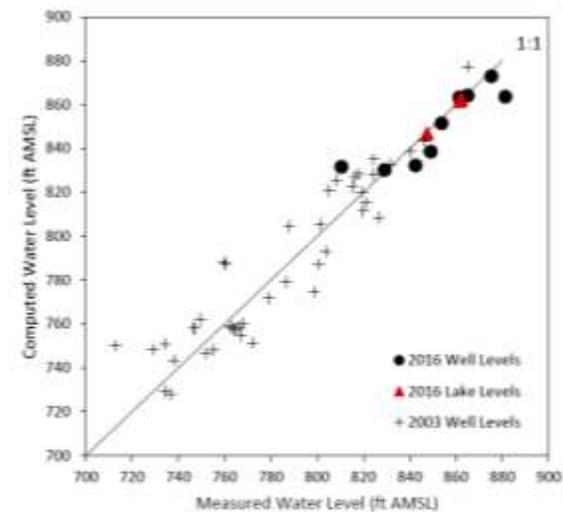
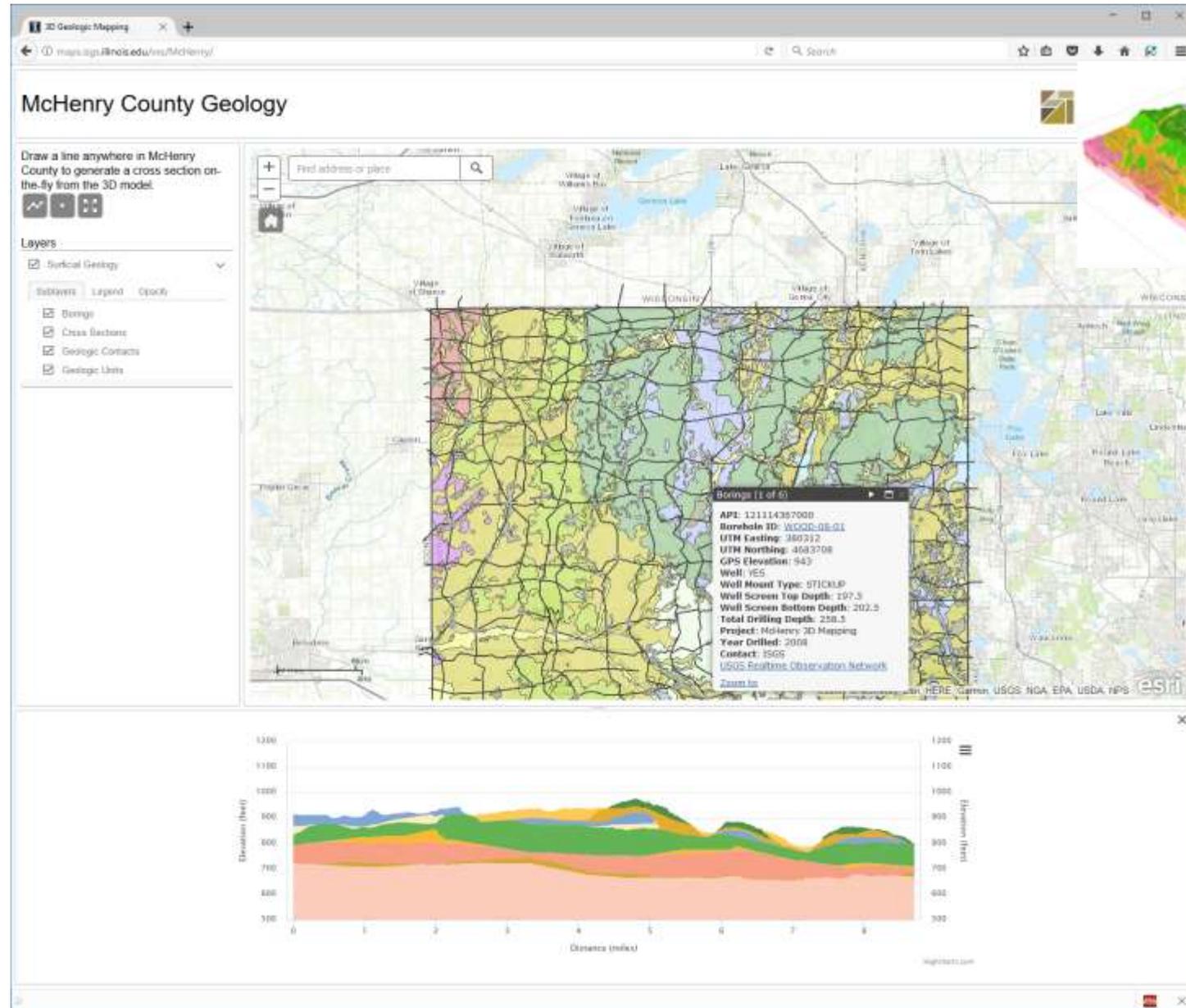


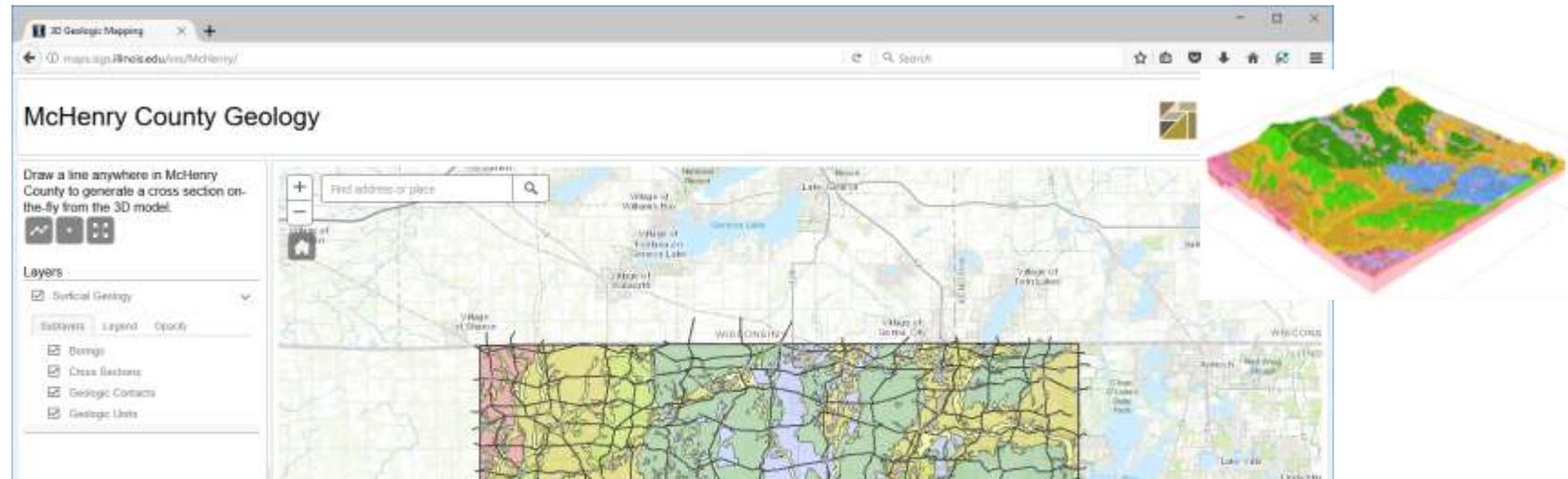
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# Online viewers/data services



# Online viewers/data services



Online interactive products

[McHenry](http://www.maps.isgs.illinois.edu/vxs/mchenry) [www.maps.isgs.illinois.edu/vxs/mchenry](http://www.maps.isgs.illinois.edu/vxs/mchenry)

