

Ohio Karst

Douglas Aden
Ohio Department of Natural Resources
Division of Geological Survey



Rain and carbon dioxide react to form weak carbonic acid ($\text{H}_2\text{O} + \text{CO}_2 \leftrightarrow \text{H}_2\text{CO}_3$)

Bedding-plane and joint fractures enlarge by solution weathering ($\text{H}_2\text{CO}_3 + \text{CaCO}_3 \leftrightarrow \text{H}_2\text{Ca}(\text{CO}_3)_2$)

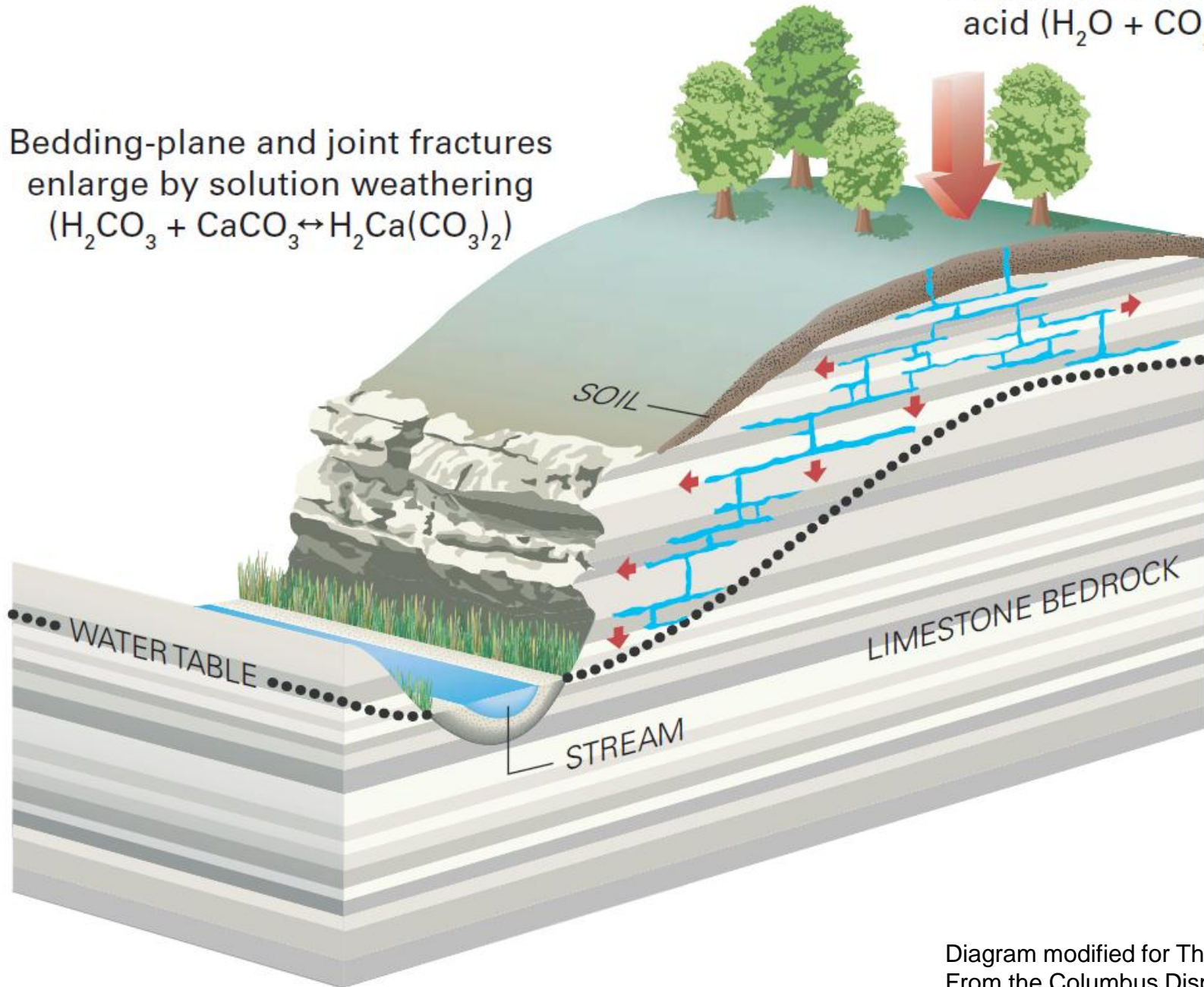


Diagram modified for The Bellevue Report, From the Columbus Dispatch.

Sinkhole forms where soil and limestone rubble subside into subterranean voids

Enlargement of bedding-plane and joint fractures by solution weathering continues

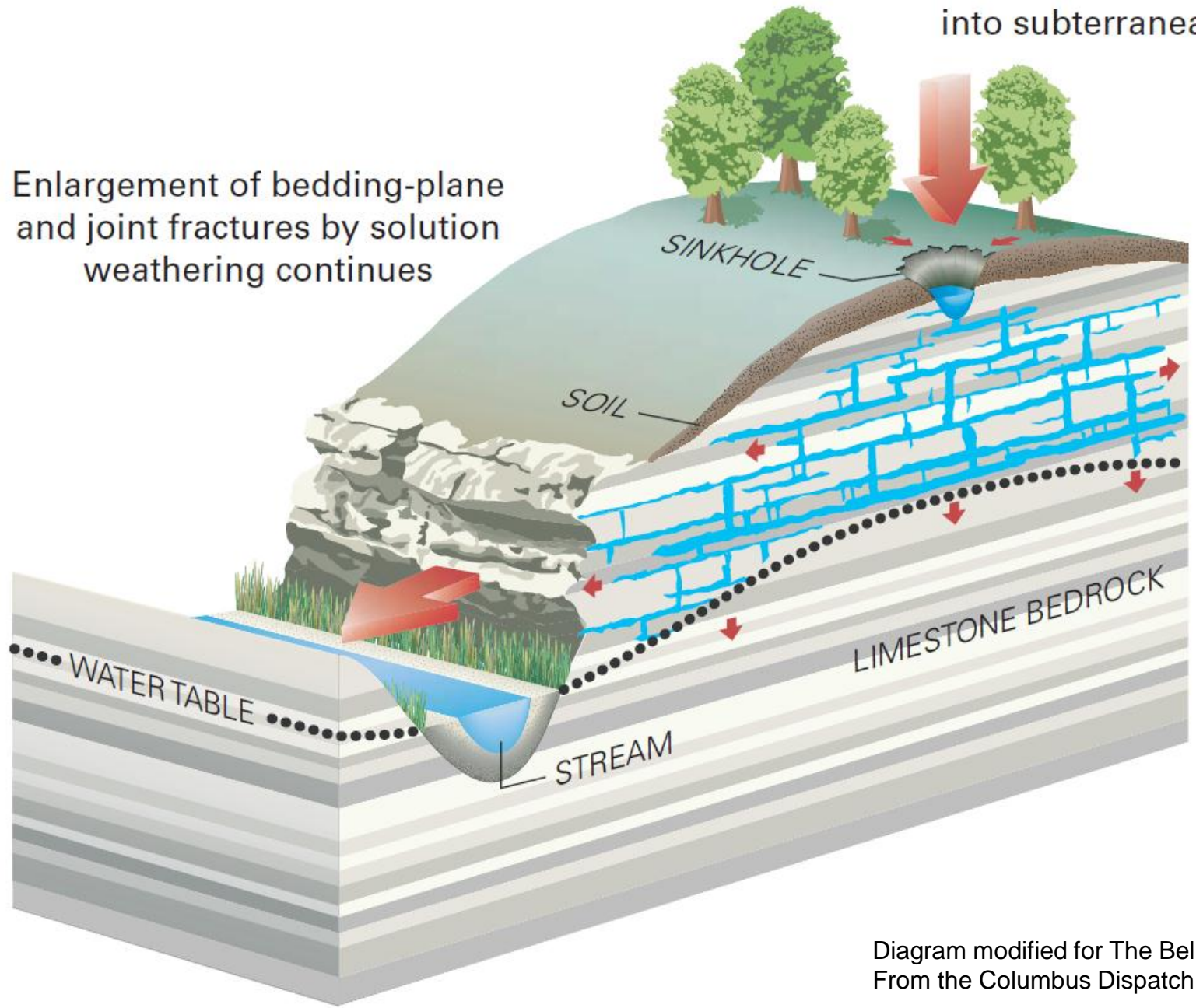


Diagram modified for The Bellevue Report, From the Columbus Dispatch.

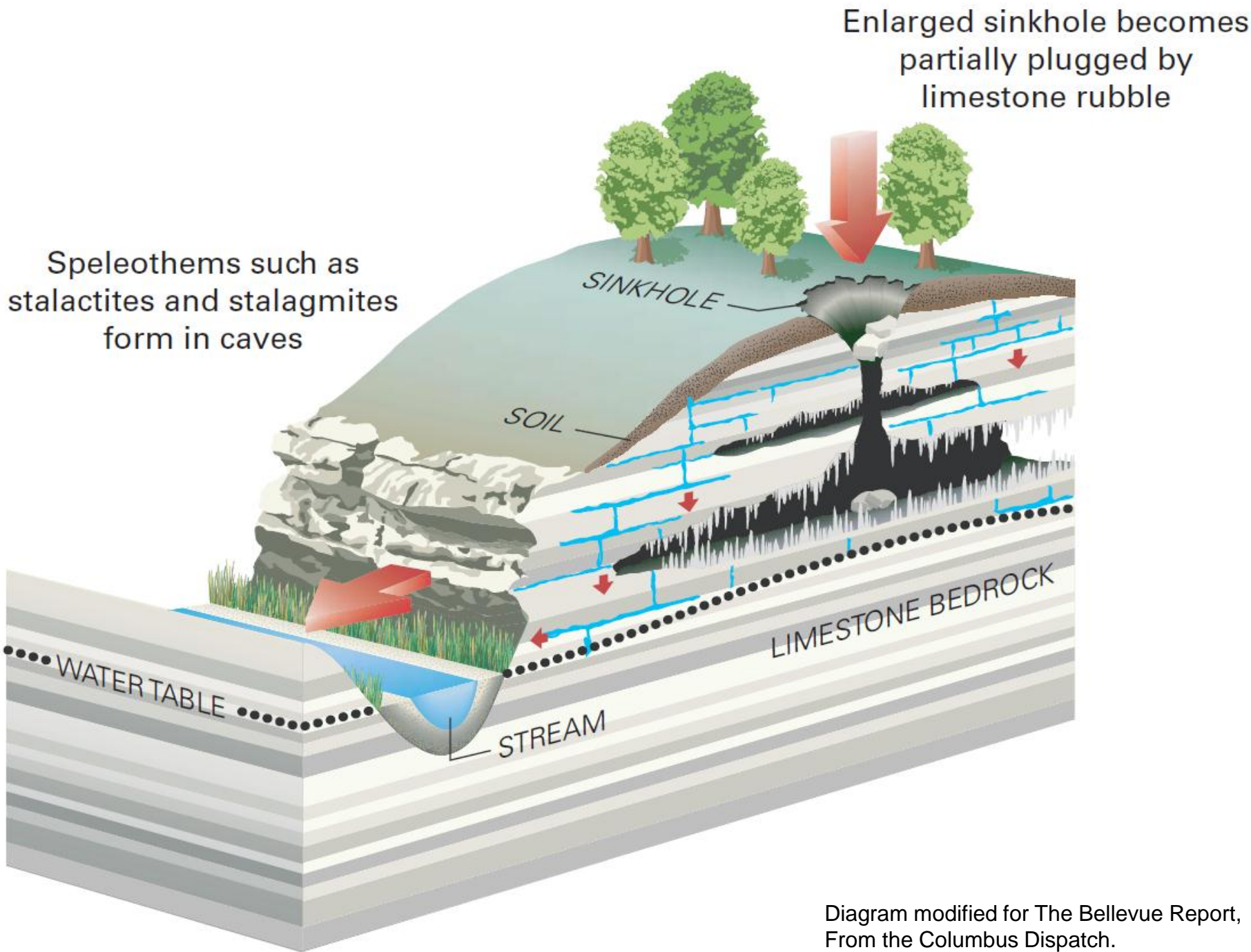
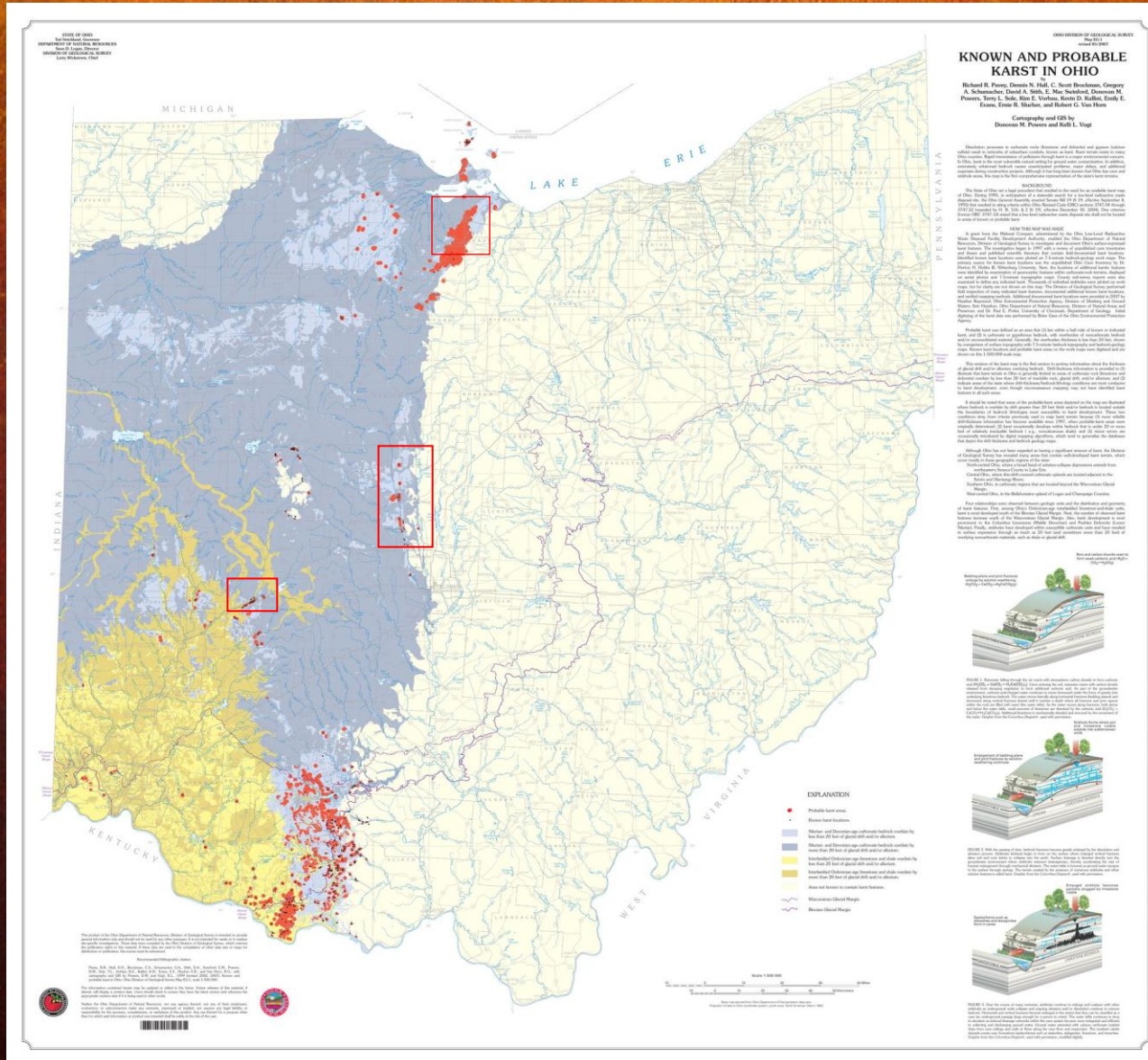


Diagram modified for The Bellevue Report, From the Columbus Dispatch.

Known and Probable Karst in Ohio EG-1

revised 5-2007



KNOWN AND PROBABLE KARST IN OHIO

Richard R. Pevy, Dennis N. Hill, C. Scott Bowman, Gregory A. Schrammer, David A. Sisk, E. Mic Sandford, Donovan M. Powers, Terry J. Sisk, Kim E. Upton, Keith D. Kubie, Emily E. Evans, Ernie B. Starker, and Robert C. Van Horn

Cartography and GIS by
Doreen M. Powers and Rob L. Vign

This document is a technical report prepared for the Ohio Department of Natural Resources, Division of Geological Survey, and is intended to provide information on the known and probable karst in Ohio. It is not a scientific study and should not be used as a basis for legal or regulatory actions.

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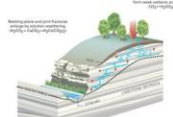


Figure 1. Karst terrain showing a surface with trees, a layer of soil, and underlying rock layers. A red box highlights a specific area of karst.



Figure 2. Karst terrain showing a surface with trees, a layer of soil, and underlying rock layers. A red box highlights a specific area of karst.

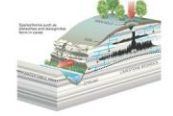


Figure 3. Karst terrain showing a surface with trees, a layer of soil, and underlying rock layers. A red box highlights a specific area of karst.

Mapping Locations

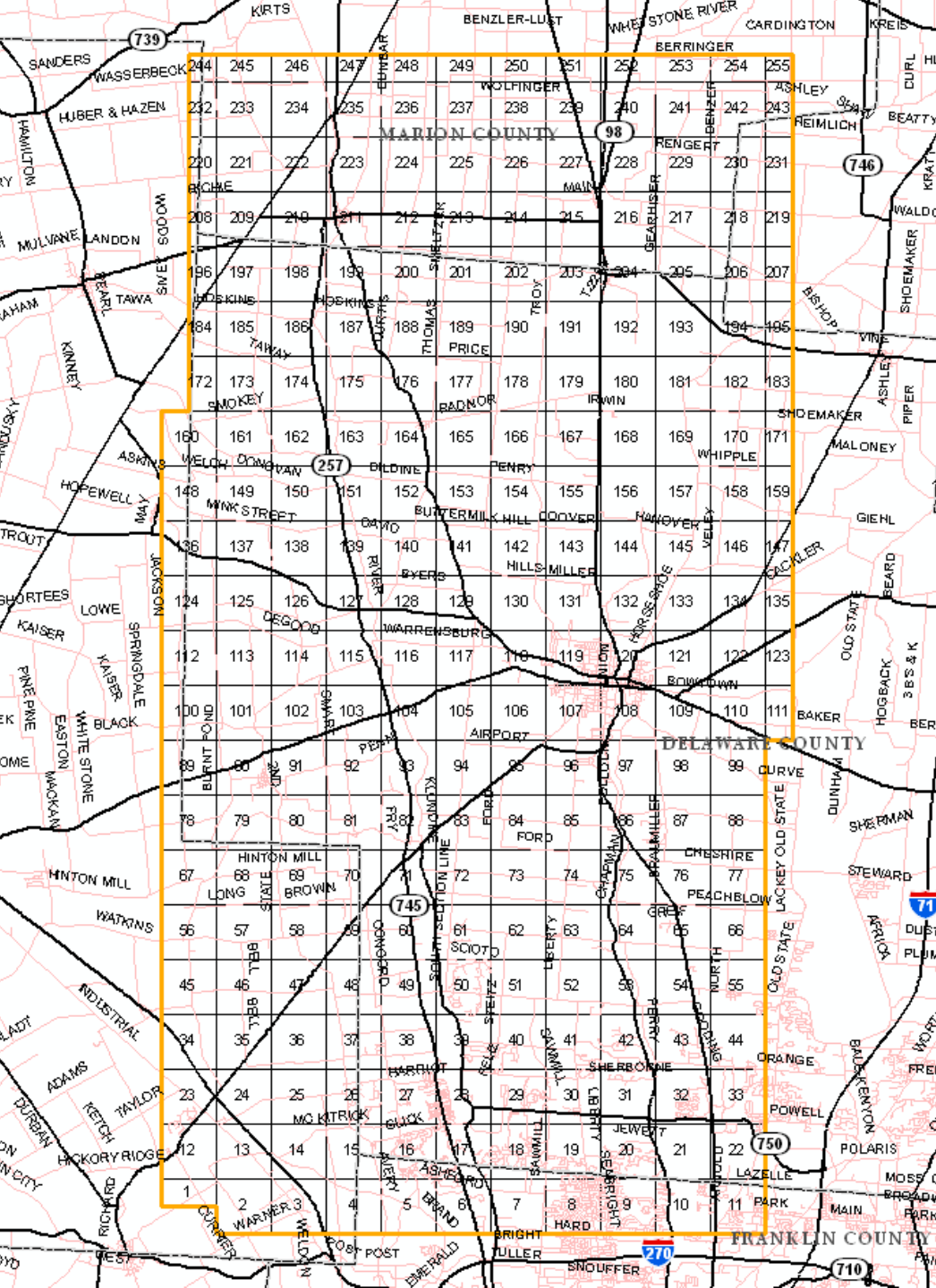
- Delaware is the fastest growing county in Ohio; increased more than 25% in population from 2000-2010 (US Census Bureau). Development on karst terrain is ongoing.
- Known groundwater contamination in Clark Co.; site of OEPA dye tracing.
- The Bellevue area has a history of contamination and karst flooding.

Methods

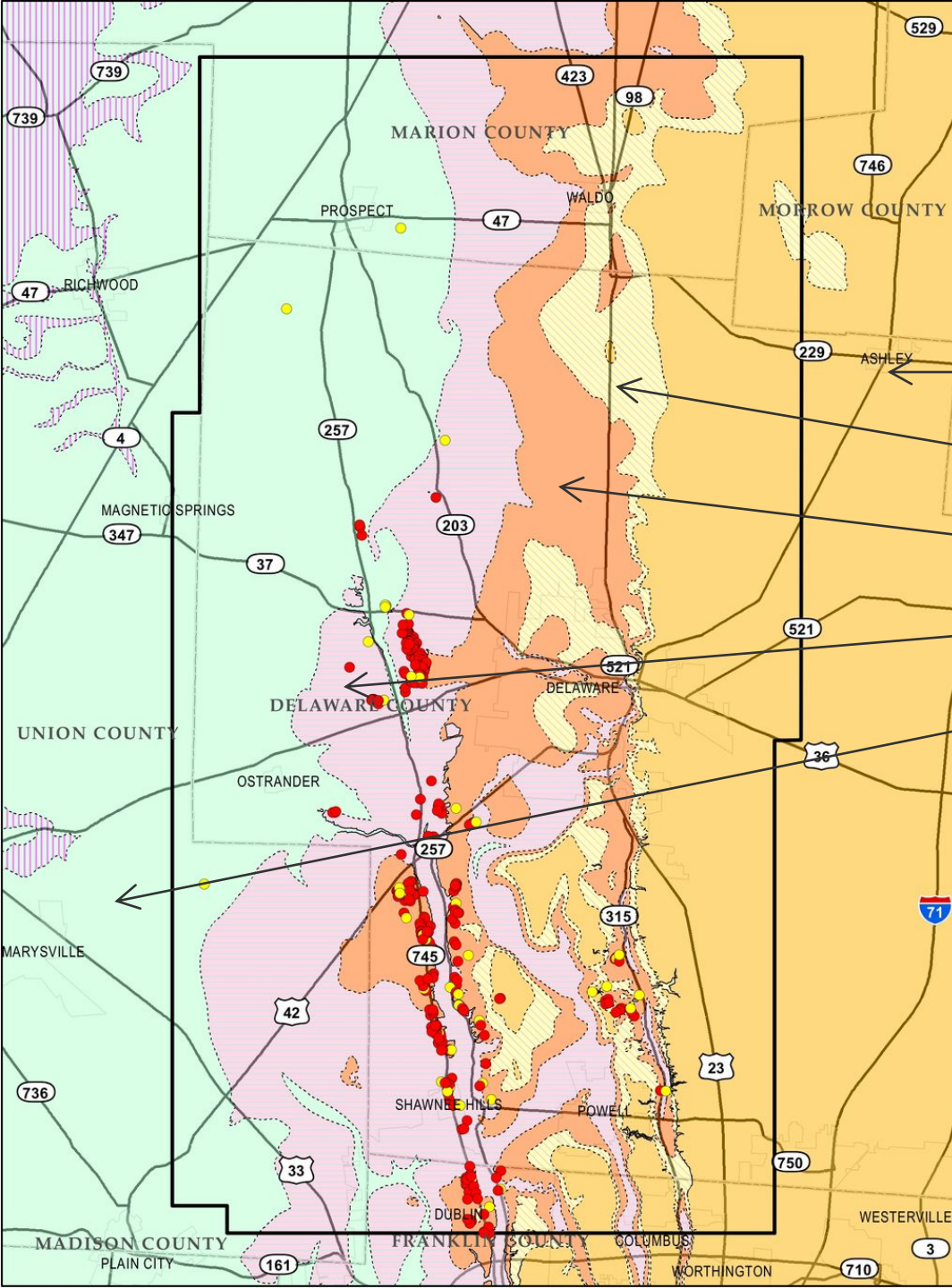
- **Imagery**
 - 2010 and older @ 0.5 and 1ft per-pixel
- **OSIP LiDAR**
 - 2006 @ 0.5ft vertical accuracy on a 2.5 ft. grid
- **LiDAR (Light Distance And Ranging) data processing**
 - DEM tile mosaicing
 - 'Fill Sinks', extract depth polygons
 - Create page grid for detailed map book

Delaware Study Area

- Area covered by six USGS 7.5-minute quadrangles
- 255 4km² tiles considered
- Mostly Delaware county
- Parts of Franklin, Union, Marion and Morrow counties



Bedrock geology



Ohio Shale

Olentangy Shale

Delaware Limestone

Columbus Limestone

Salina Undifferentiated

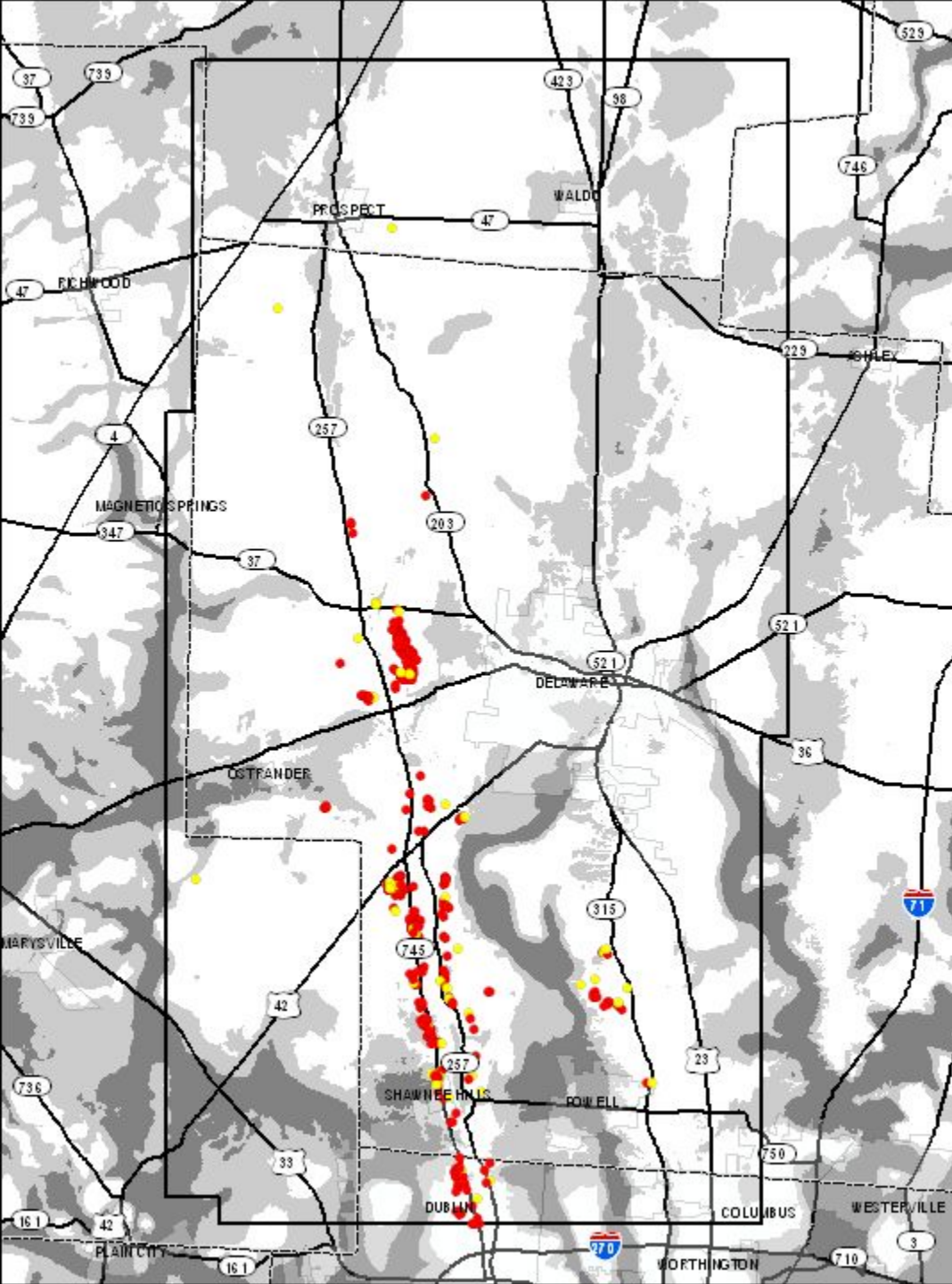
Sinkholes located
in limestone

Columbus Limestone



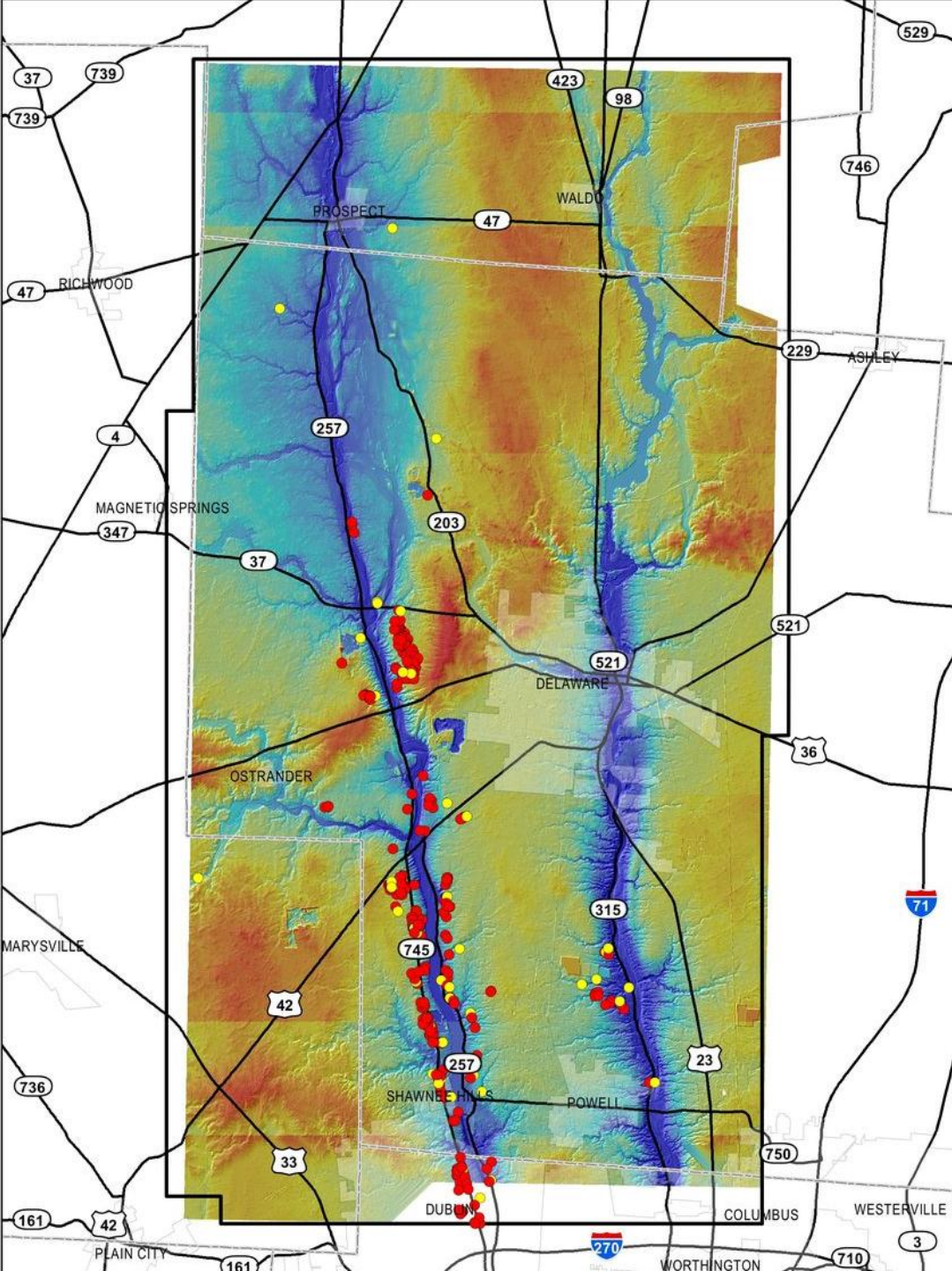
Drift thickness

- Sinkholes concentrated in areas of thin glacial till



DEM

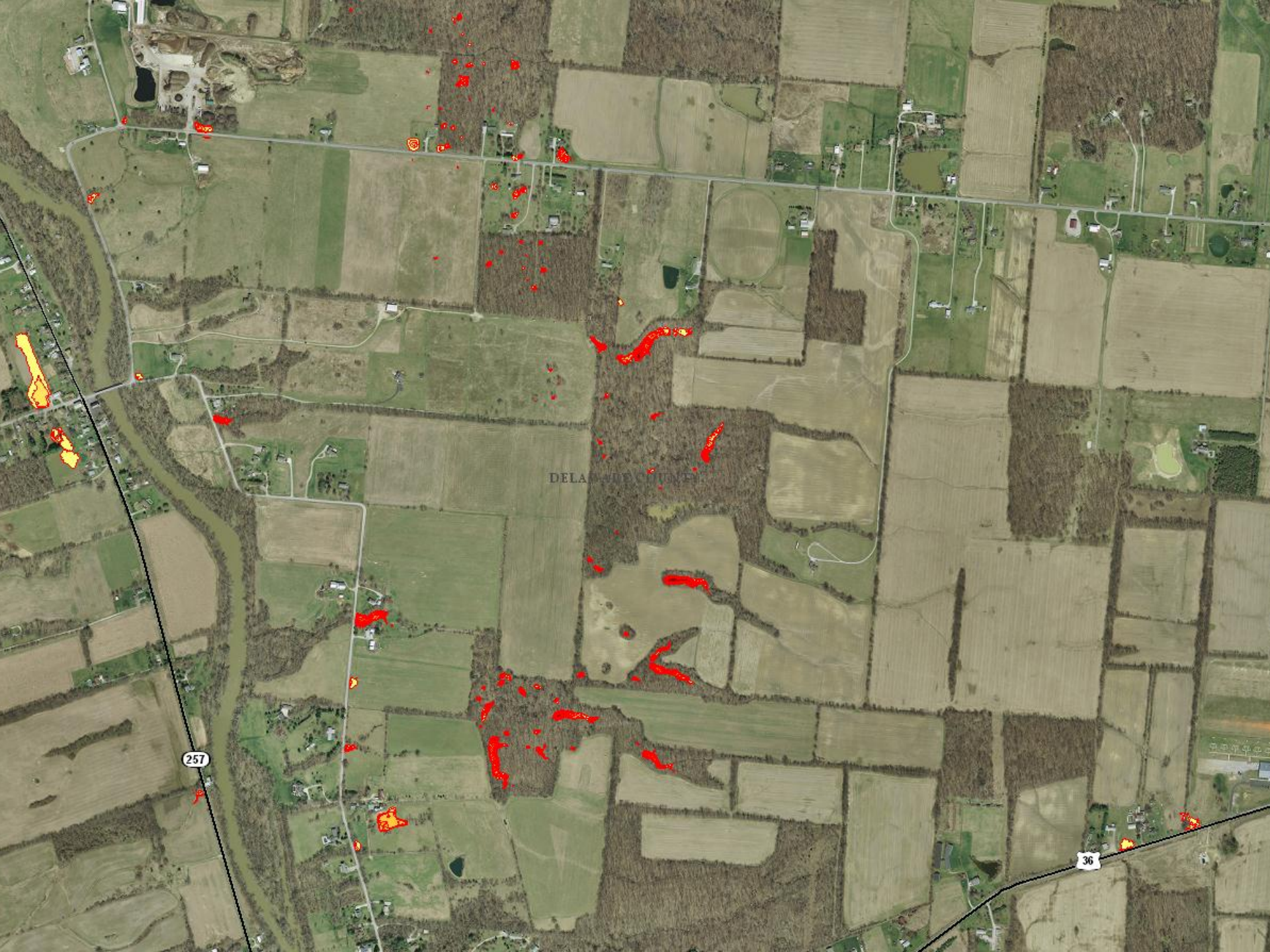
- Sinkholes concentrated along river channels



Non-Karst 'Sinks'

- Stream bank/ water reflections
- Culverts/ bridges
- Storm drains
- Foundations





DELAWARE COUNTY

257

36





1988 ■ Photos can monitor growth over time

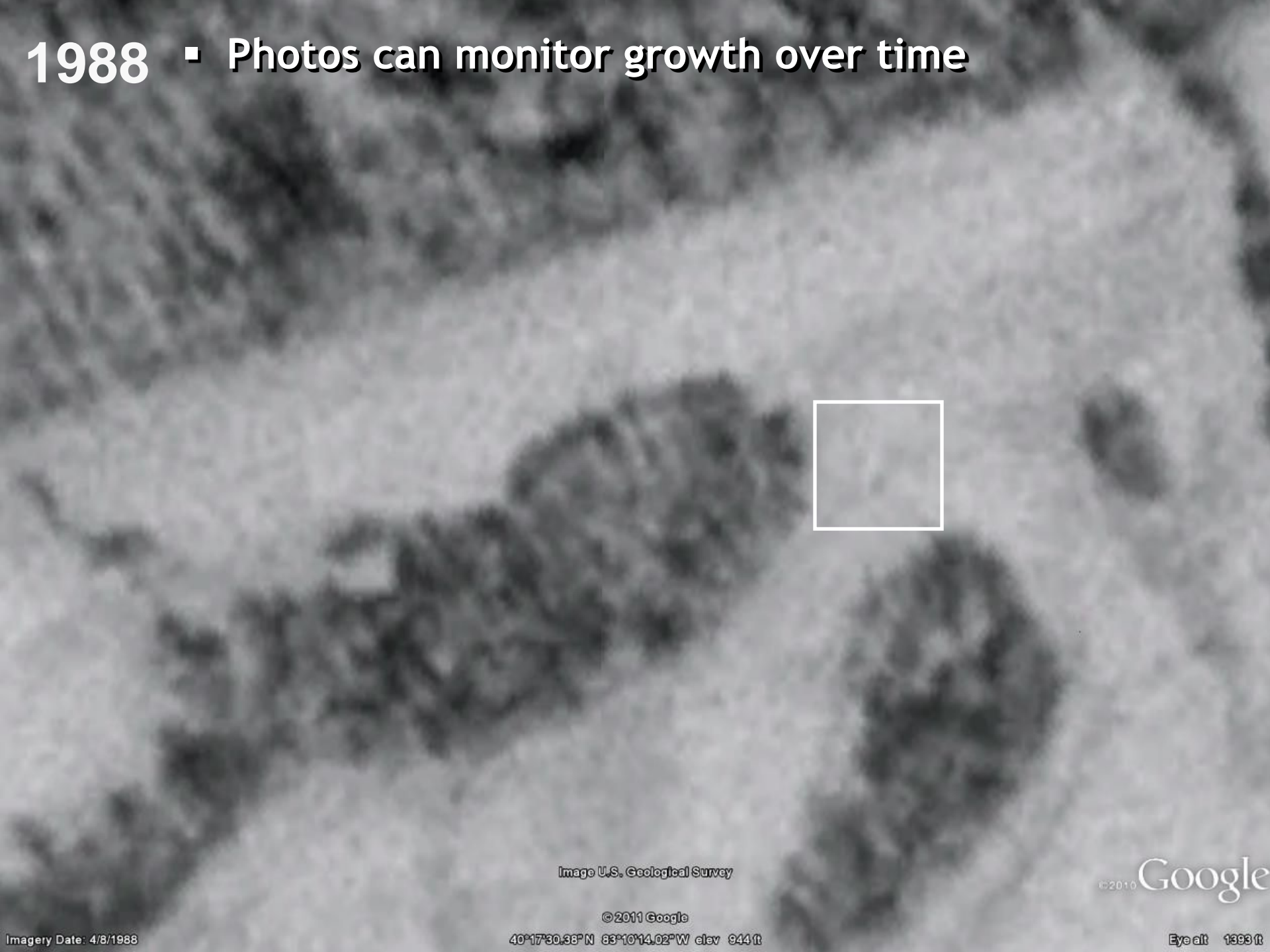


Image U.S. Geological Survey

©2010 Google

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40°17'30.38"N 83°10'14.02"W elev 944 ft

Imagery Date: 4/8/1988

Eye alt 1393 ft

2002



Image U.S. Geological Survey

©2010 Google

© 2011 Google

Imagery Date: 4/30/2002

40°17'30.44"N 83°10'13.73"W elev 943 ft

Eye alt 1393 ft

2006



Image State of Ohio / OSIP

©2010 Google

©2011 Google

Imagery Date: 2/28/2006

40°17'30.38"N 83°10'14.02"W elev 944 ft

Eye alt 1393 ft

2007

DELAWARE COUNTY

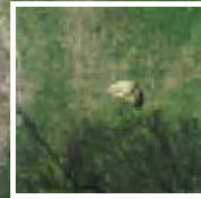
103



2008

DELAWARE COUNTY

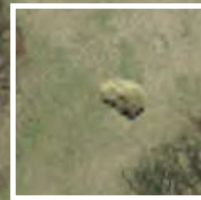
103



2010

DELAWARE COUNTY

103



Mid.
2011







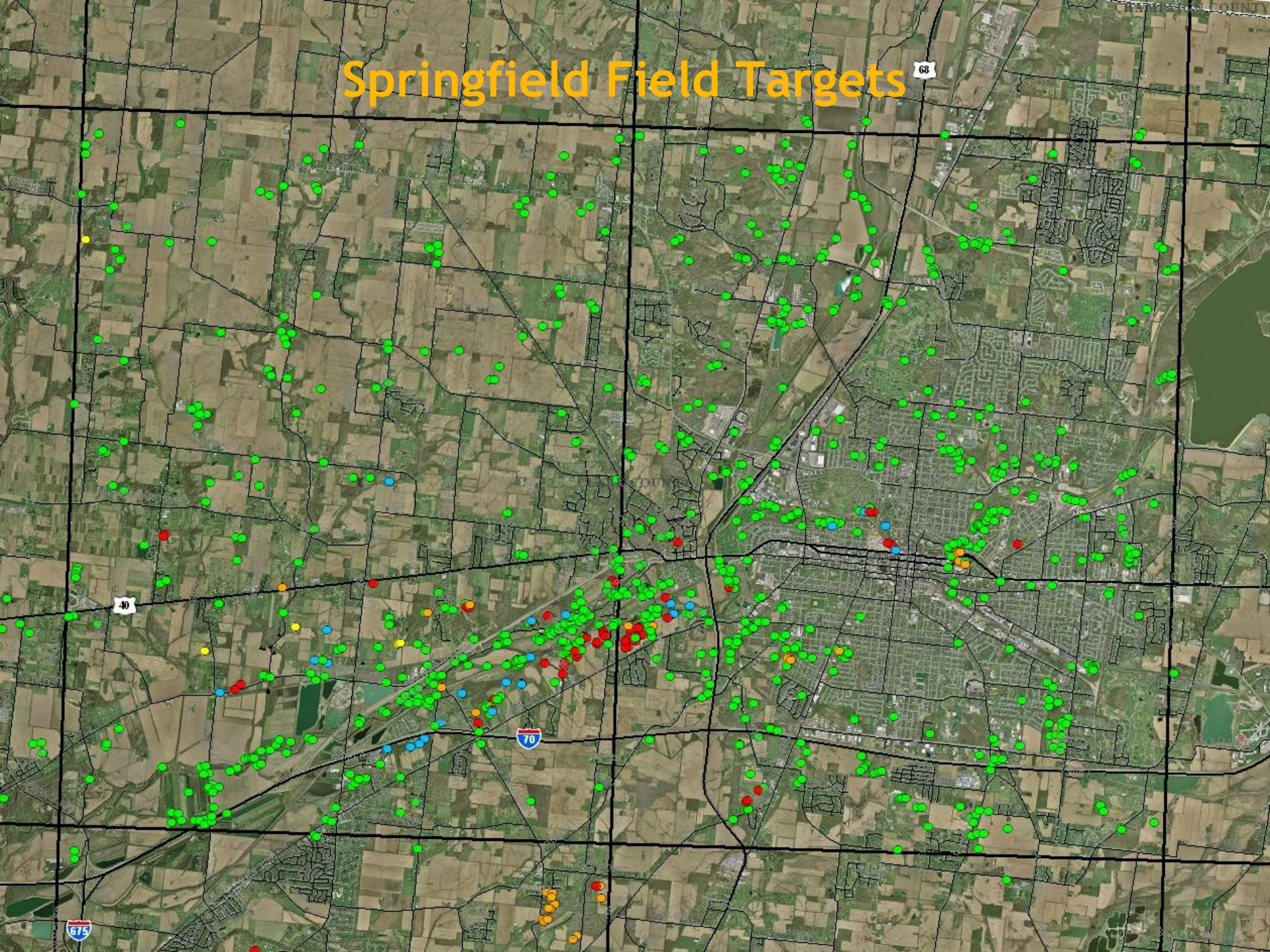


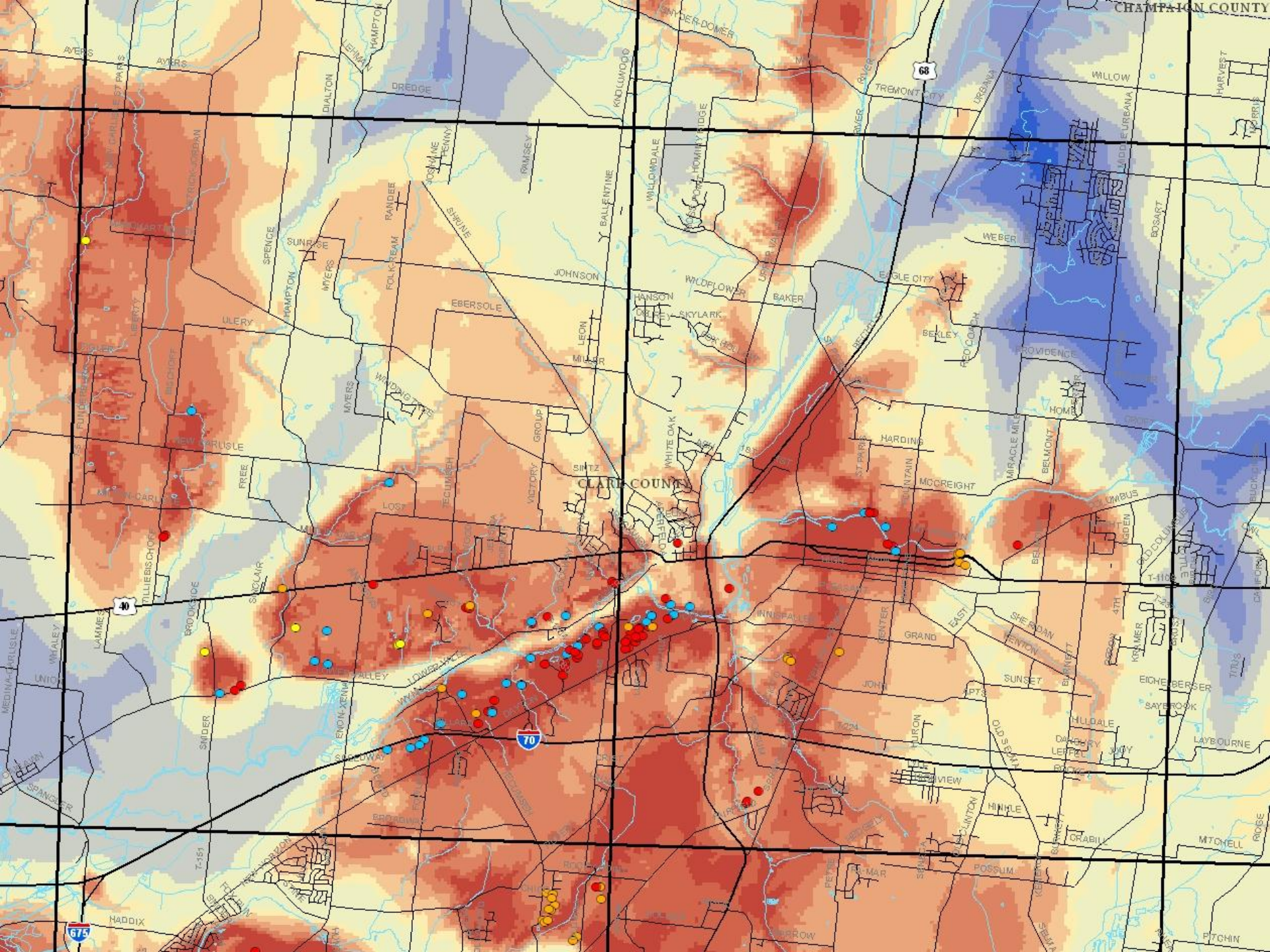


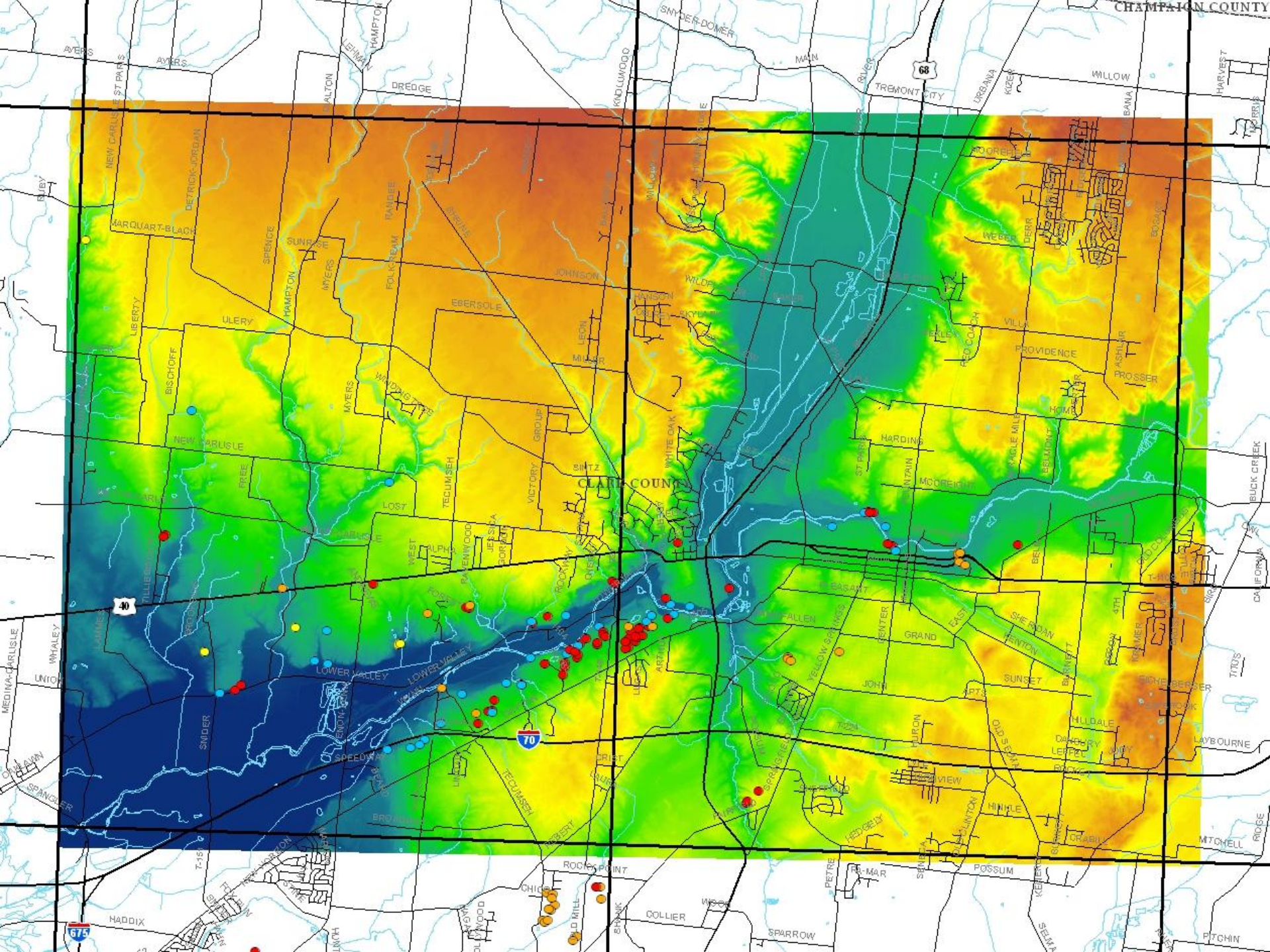
Delaware Statistics

- 354 field verified sinkholes
- 51 'Potential' points
- 69% have LiDAR signature
- 6 springs found

Springfield Field Targets







CLARK COUNTY

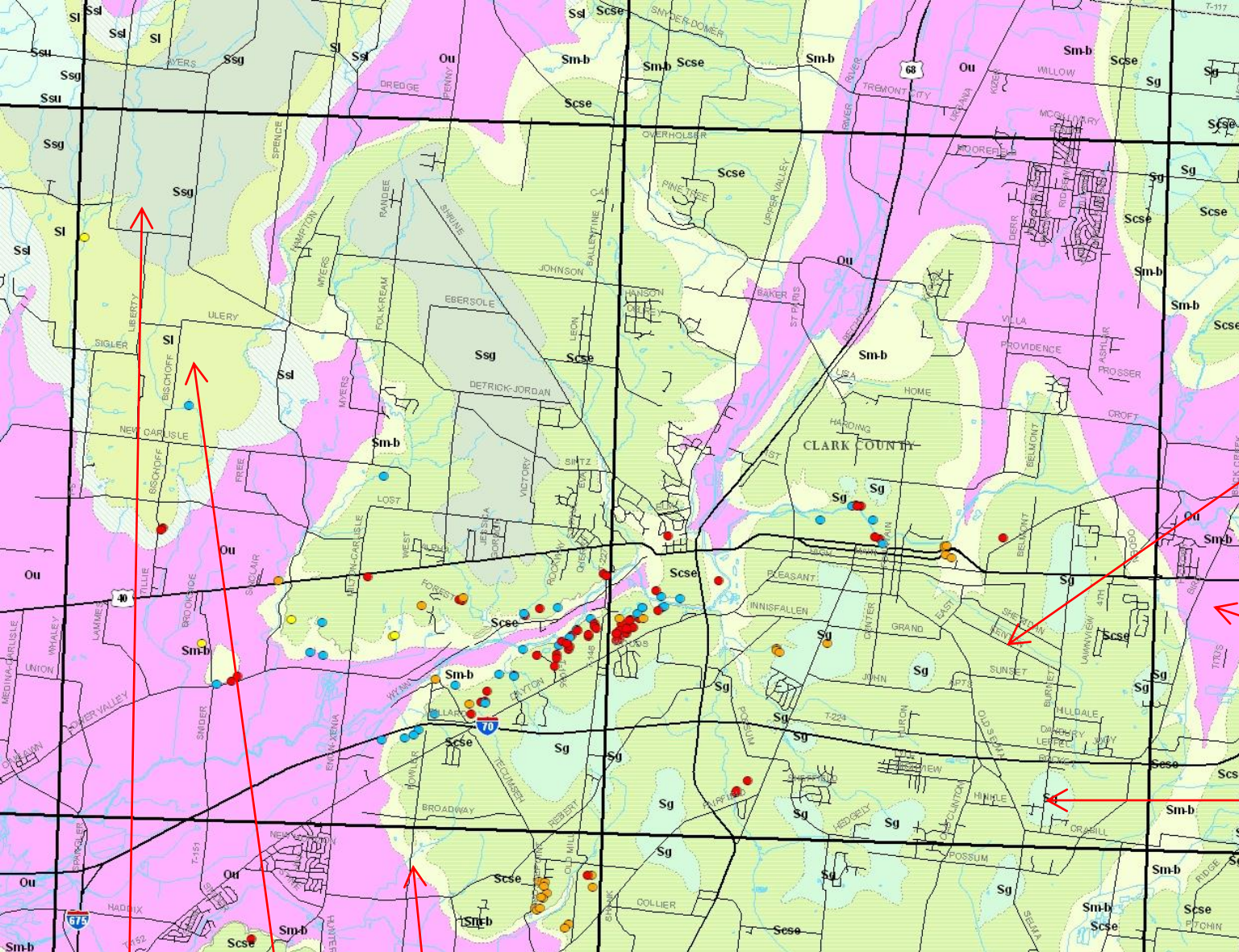
68

40

70

67

Bedrock geology



Cedarville,
Springfield,
Euphemia Dol.

Ordovician un.

Greenfield Dol.

Salina Undiff.

Shl. Dol. Lst. Un.

Lockport Dol.

Sinkholes located
in dolomite

Karst forming units

- The contact between the blocky Cedarville Dol. and the fractured Springfield Dol.



Cedarville Dolomite

Springfield Dolomite











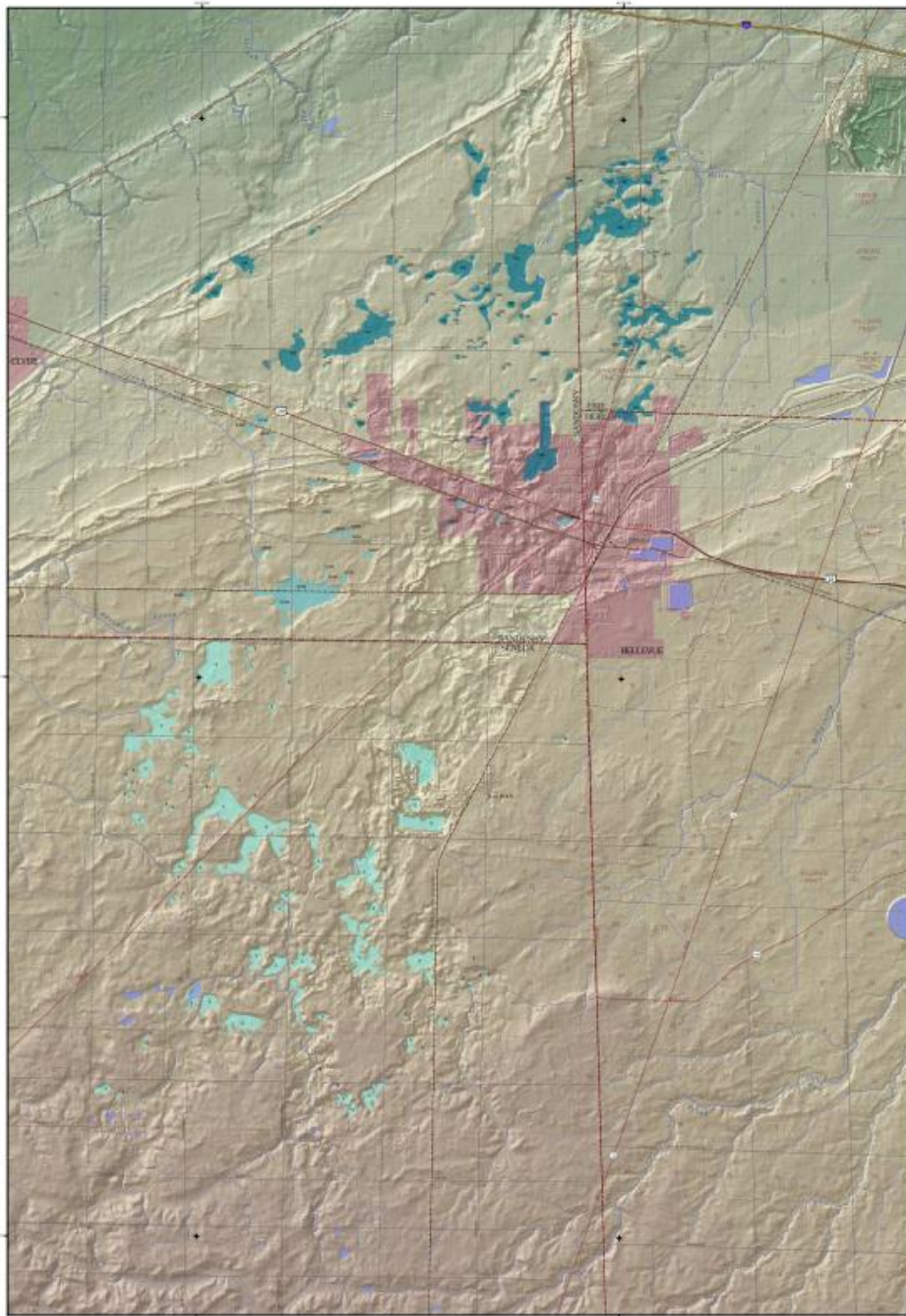
IMPORTANT
WATER SAMPLES
MAY BE CONTAMINATED
IF THE BATTERY IS
NOT SECURED

12V 10Ah
LiFePO4

2A 3A8
12V 10Ah

Clark Co. Statistics

- 960 total points examined, 114 identified as karst.
- 59 confirmed as sinks, caves or solution enlarged fracture.
- 17 visited & suspect.
- 5 not visited but suspect.
- 33 springs (only 6 found in Delaware Co.)



INTRODUCTION
On March 11, 2008, approximately 3.5 inches of rain fell over the Bellevue area, Ohio. This rainfall, combined with the snowmelt from the previous winter, caused significant flooding in the area. The flooding was caused by a combination of factors, including the high water table, the presence of karst features, and the saturated ground. The flooding affected a large area of the Bellevue area, including the town of Bellevue and the surrounding countryside. The flooding was caused by a combination of factors, including the high water table, the presence of karst features, and the saturated ground. The flooding affected a large area of the Bellevue area, including the town of Bellevue and the surrounding countryside.

HYDROLOGIC CONDITIONS CAUSING THE FLOODING
The flooding was caused by a combination of factors, including the high water table, the presence of karst features, and the saturated ground. The flooding affected a large area of the Bellevue area, including the town of Bellevue and the surrounding countryside. The flooding was caused by a combination of factors, including the high water table, the presence of karst features, and the saturated ground. The flooding affected a large area of the Bellevue area, including the town of Bellevue and the surrounding countryside.

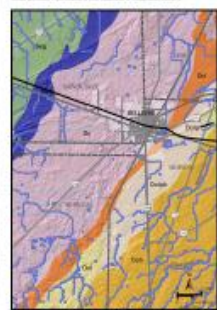
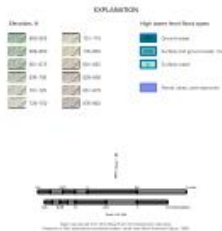
GEOLOGY OF THE BELLEVUE AREA
The Bellevue area is characterized by its geology, which includes the presence of karst features. The geology of the area is characterized by its presence of karst features, which are formed by the dissolution of limestone. The geology of the area is characterized by its presence of karst features, which are formed by the dissolution of limestone. The geology of the area is characterized by its presence of karst features, which are formed by the dissolution of limestone.

MAPPING THE EXTENT OF THE FLOODING
The extent of the flooding was mapped using a combination of data sources, including aerial photography, ground truthing, and hydrologic modeling. The extent of the flooding was mapped using a combination of data sources, including aerial photography, ground truthing, and hydrologic modeling. The extent of the flooding was mapped using a combination of data sources, including aerial photography, ground truthing, and hydrologic modeling.

CONCLUSIONS
The flooding in the Bellevue area was caused by a combination of factors, including the high water table, the presence of karst features, and the saturated ground. The flooding affected a large area of the Bellevue area, including the town of Bellevue and the surrounding countryside. The flooding was caused by a combination of factors, including the high water table, the presence of karst features, and the saturated ground. The flooding affected a large area of the Bellevue area, including the town of Bellevue and the surrounding countryside.

ACKNOWLEDGMENTS
The authors would like to thank the following individuals and organizations for their assistance in the preparation of this report: [List of names and organizations]

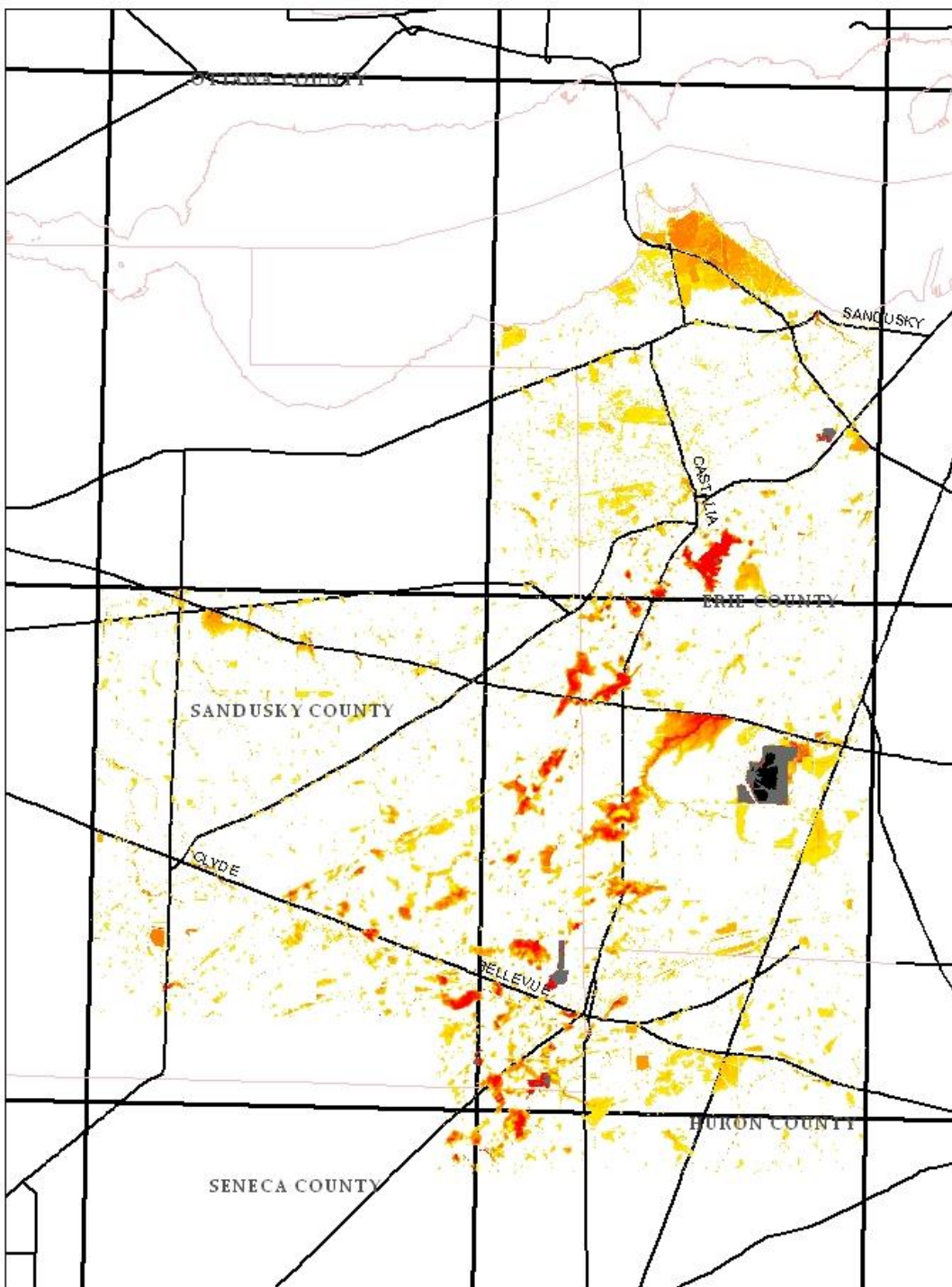
REFERENCES
Potts, R.D., Angle, M.P., Pavesi, G.M., and Sandoval, E.R. 2008. Karst flooding in Bellevue, Ohio, and vicinity—2008. Ohio Department of Natural Resources, Division of Water, Columbus, Ohio. 10 p.



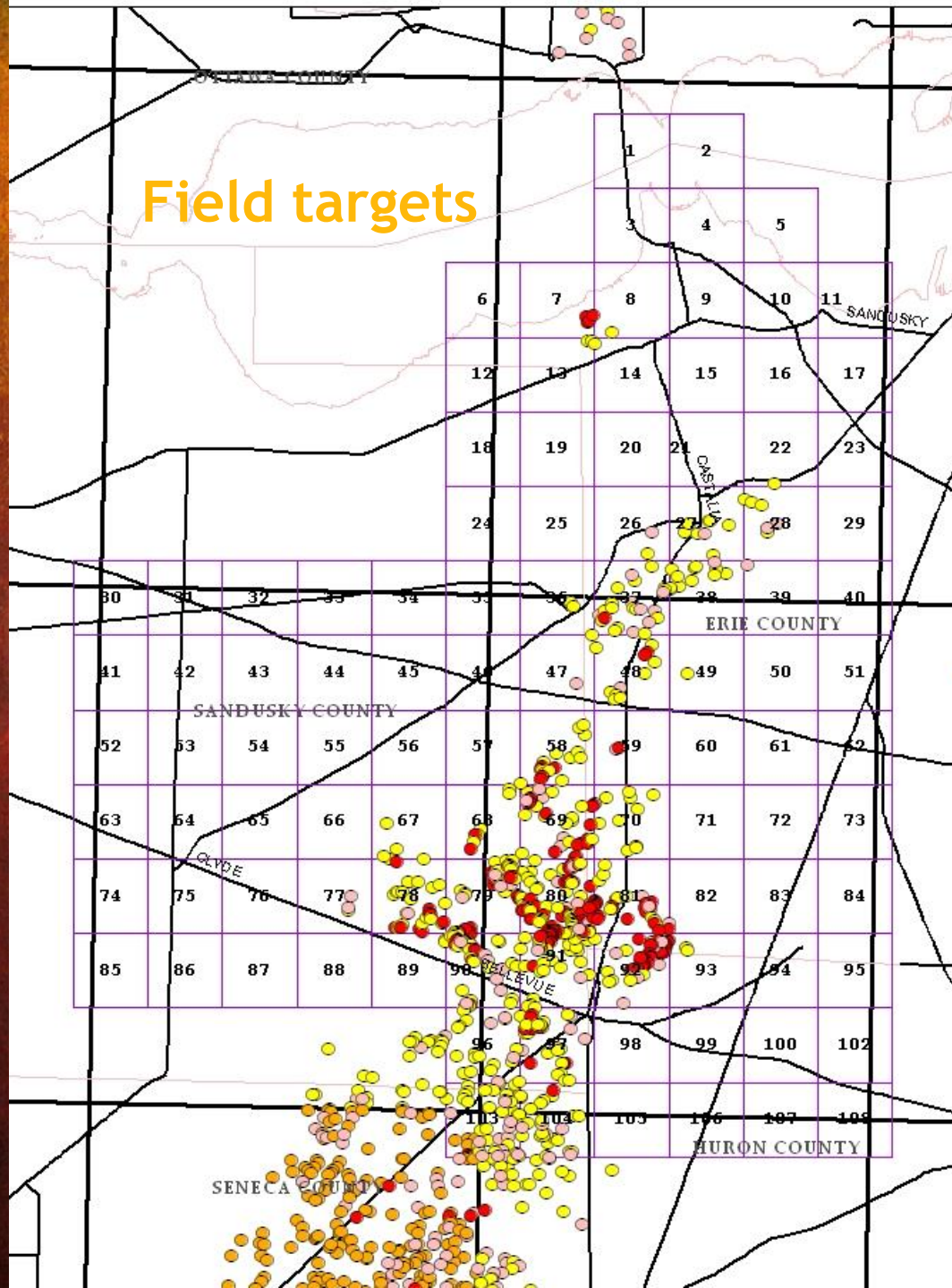
This project was funded by the Ohio Department of Natural Resources, Division of Water. The project was funded by the Ohio Department of Natural Resources, Division of Water. The project was funded by the Ohio Department of Natural Resources, Division of Water.

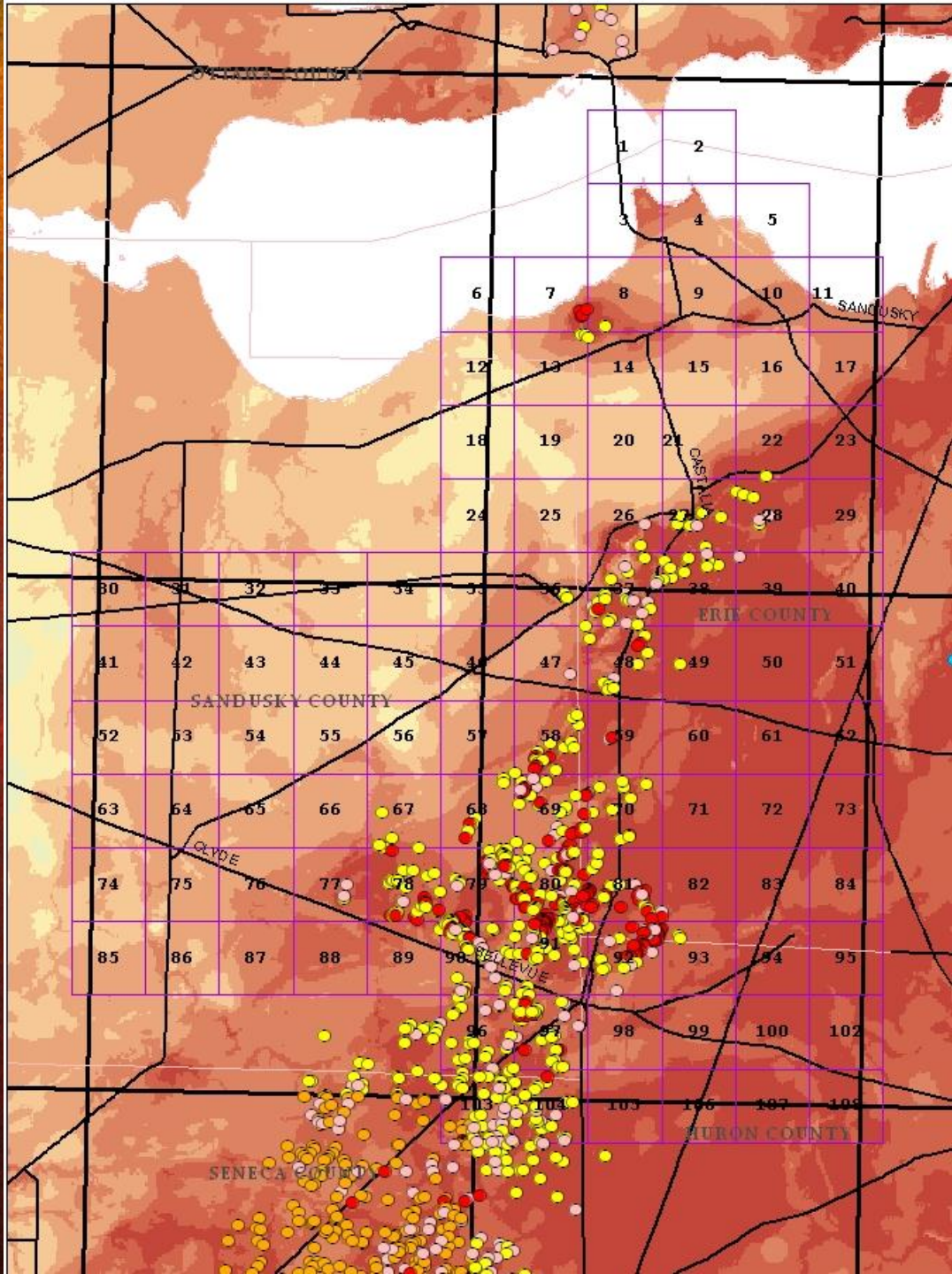
Bellevue Study Area

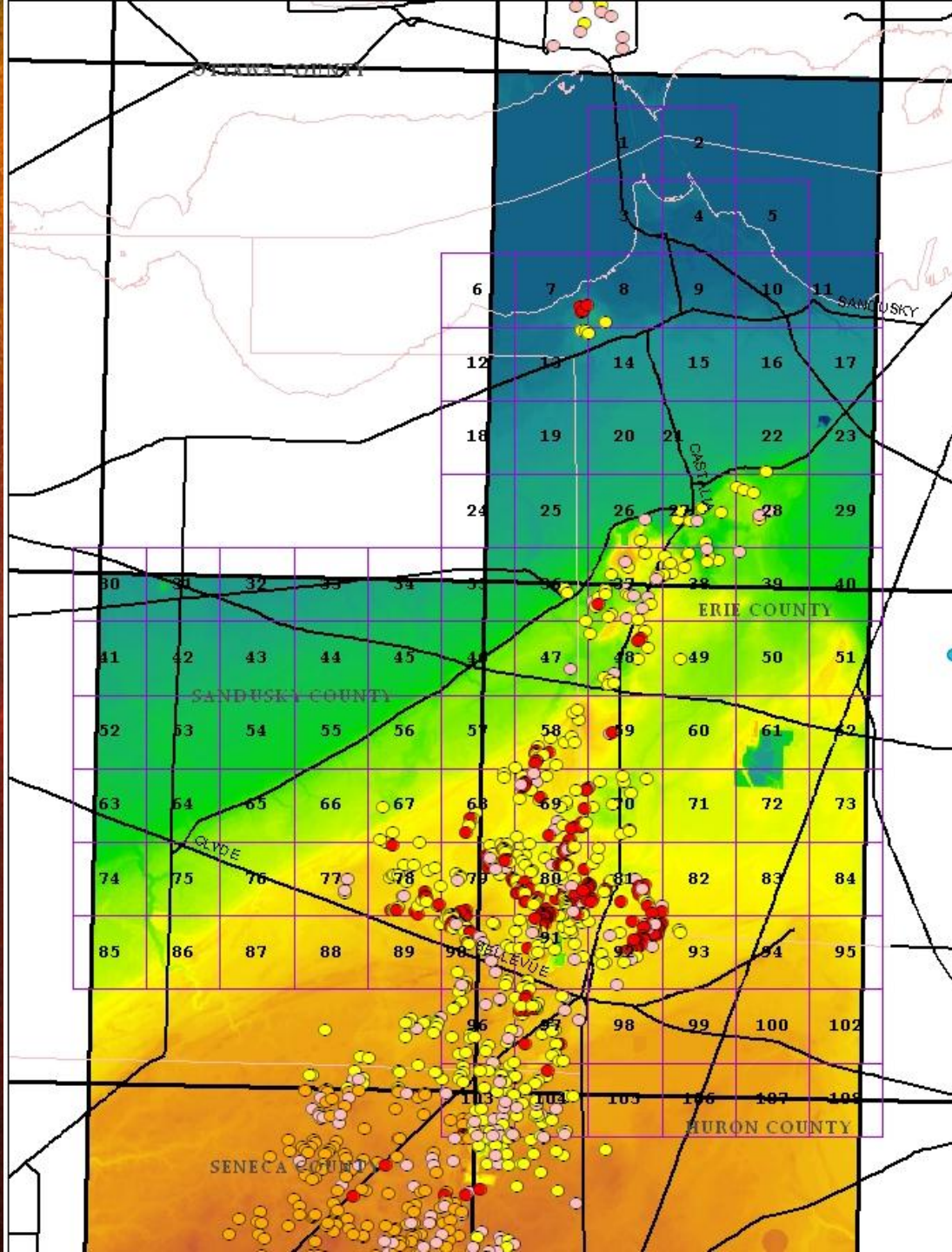
- Main area covered by the Bellevue USGS 7.5-minute quadrangle
- 108 4km² tiles considered
- Erie, Huron, Sandusky, and Seneca counties
- Field work began in the fall, when the crops are cleared



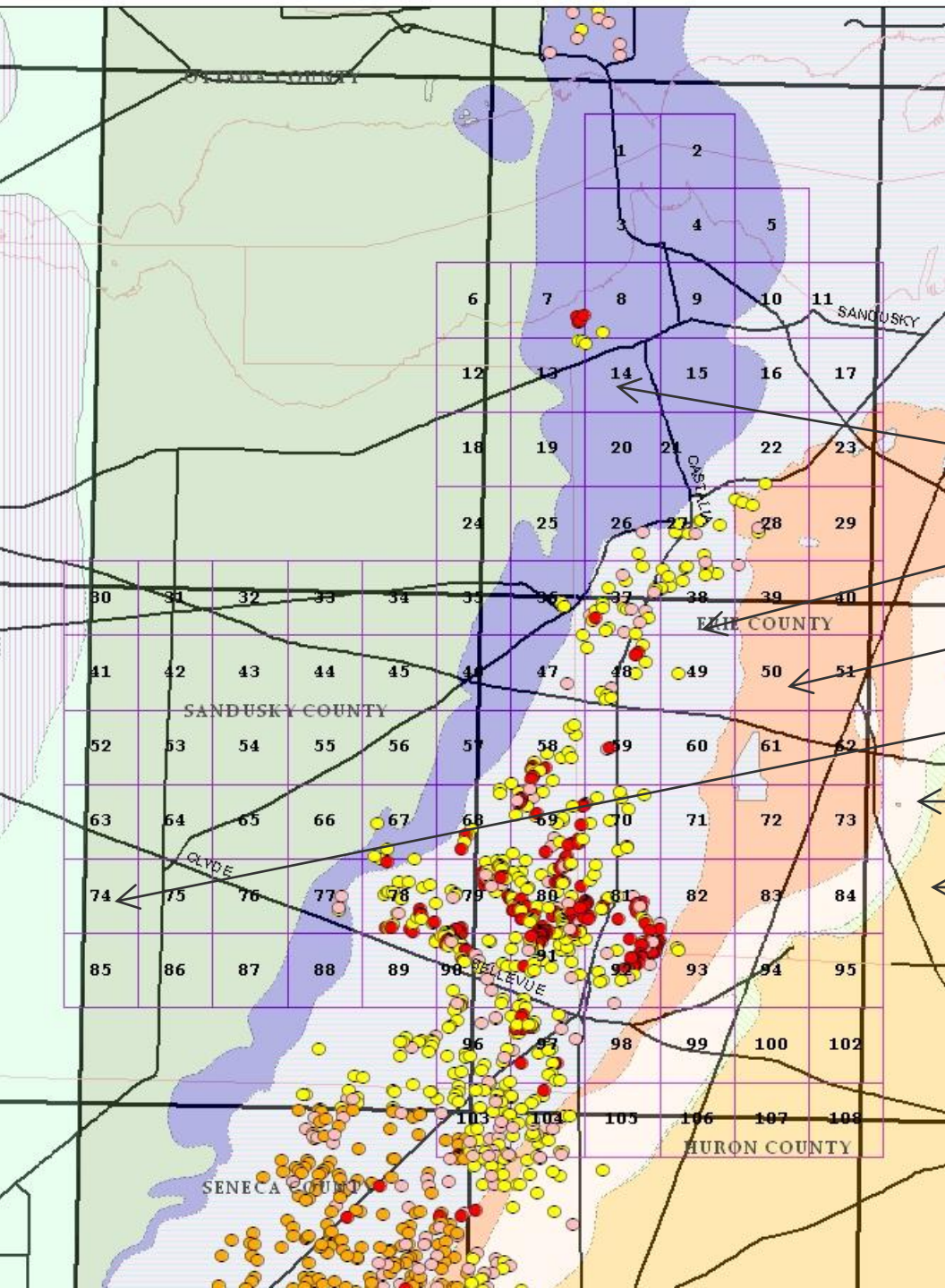
Field targets







Bedrock geology



Bass Islands Dolomite

Columbus Limestone

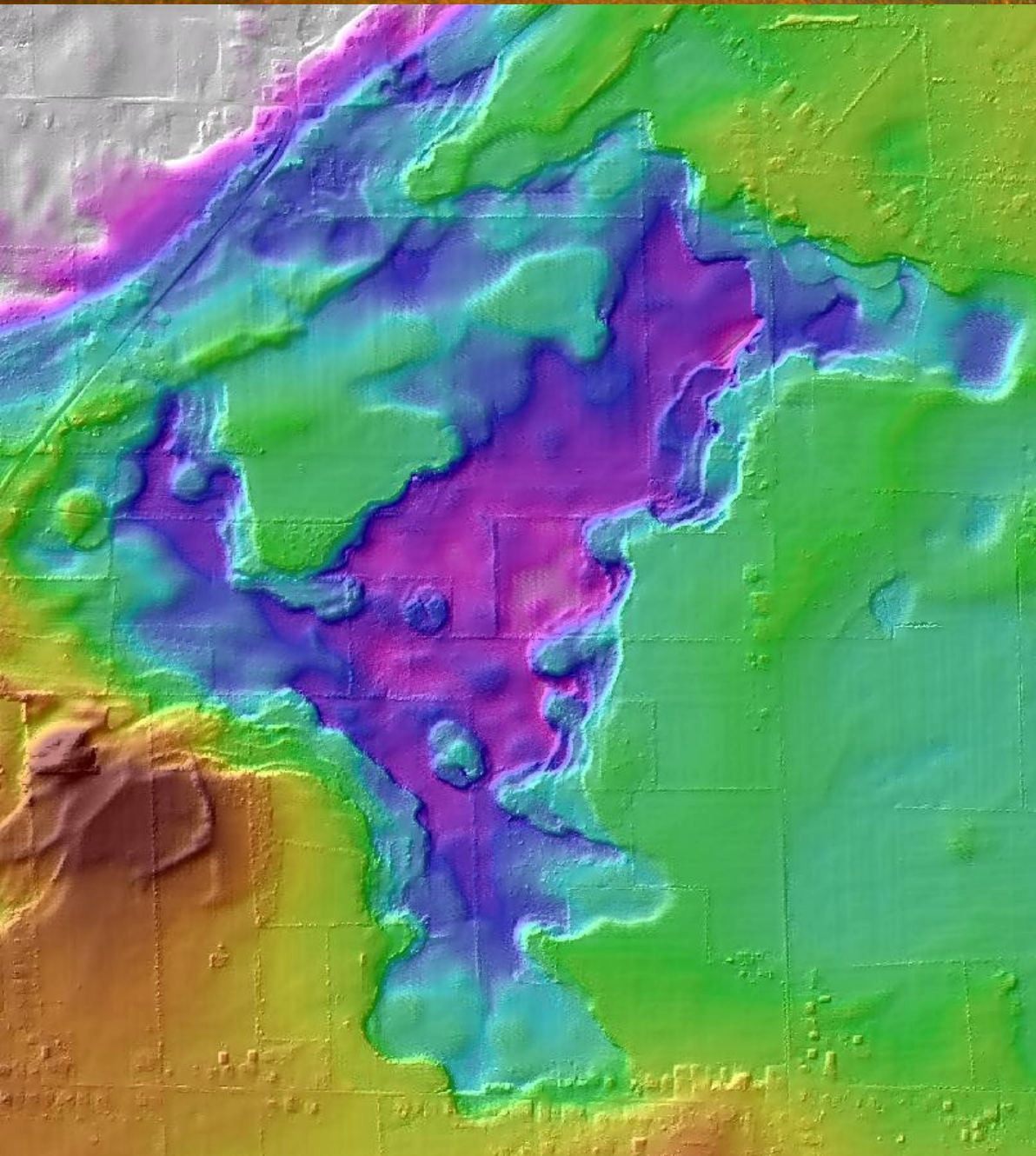
Delaware Limestone

Salina Undifferentiated

Plum Brook Shale

Ohio Shale

Sinkholes located
in carbonates and
evaporites



- Largest sink in Ohio
- 7100 feet from north to south
- Spillover ~21ft
- Some lows 35ft deeper than the adjacent upland



Completed

- Delaware
- Springfield

In Progress

- Bellevue (plus)

Proposed

- FlatRock/Fireside
- Rainsboro