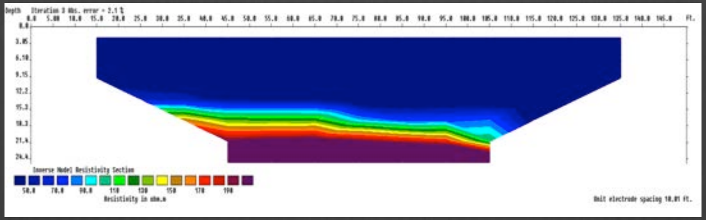
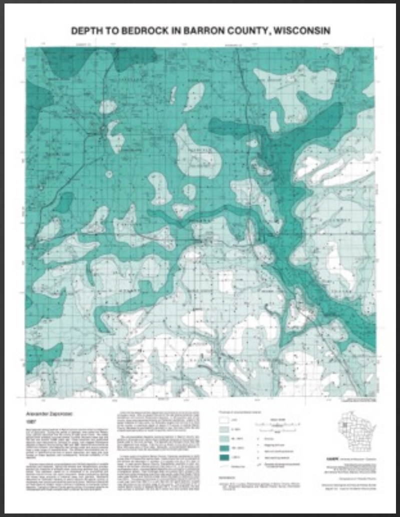
Depth to Bedrock
WGNHS Resources and Methods



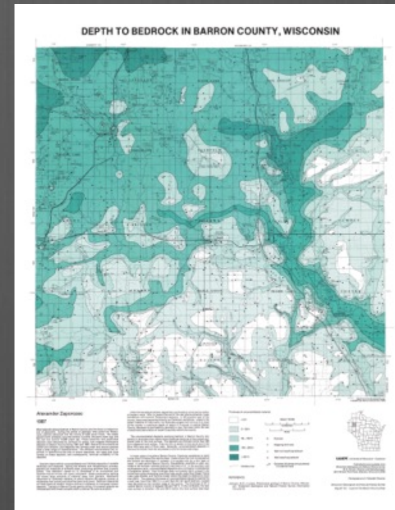


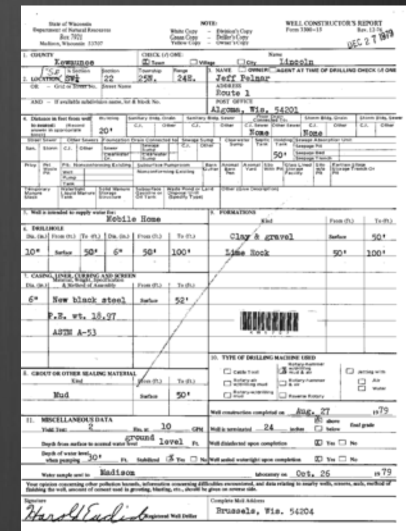
Dave Hart, Mike Parsen, Carolyn Streiff, and Steve Mauel

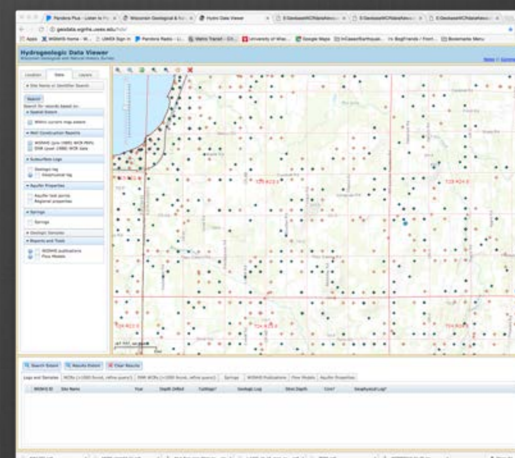
UW Extension
Wisconsin Geological and Natural History Survey

Resources

- Published Maps
- Well Construction Reports
- Hydrodata Viewer
- Staff



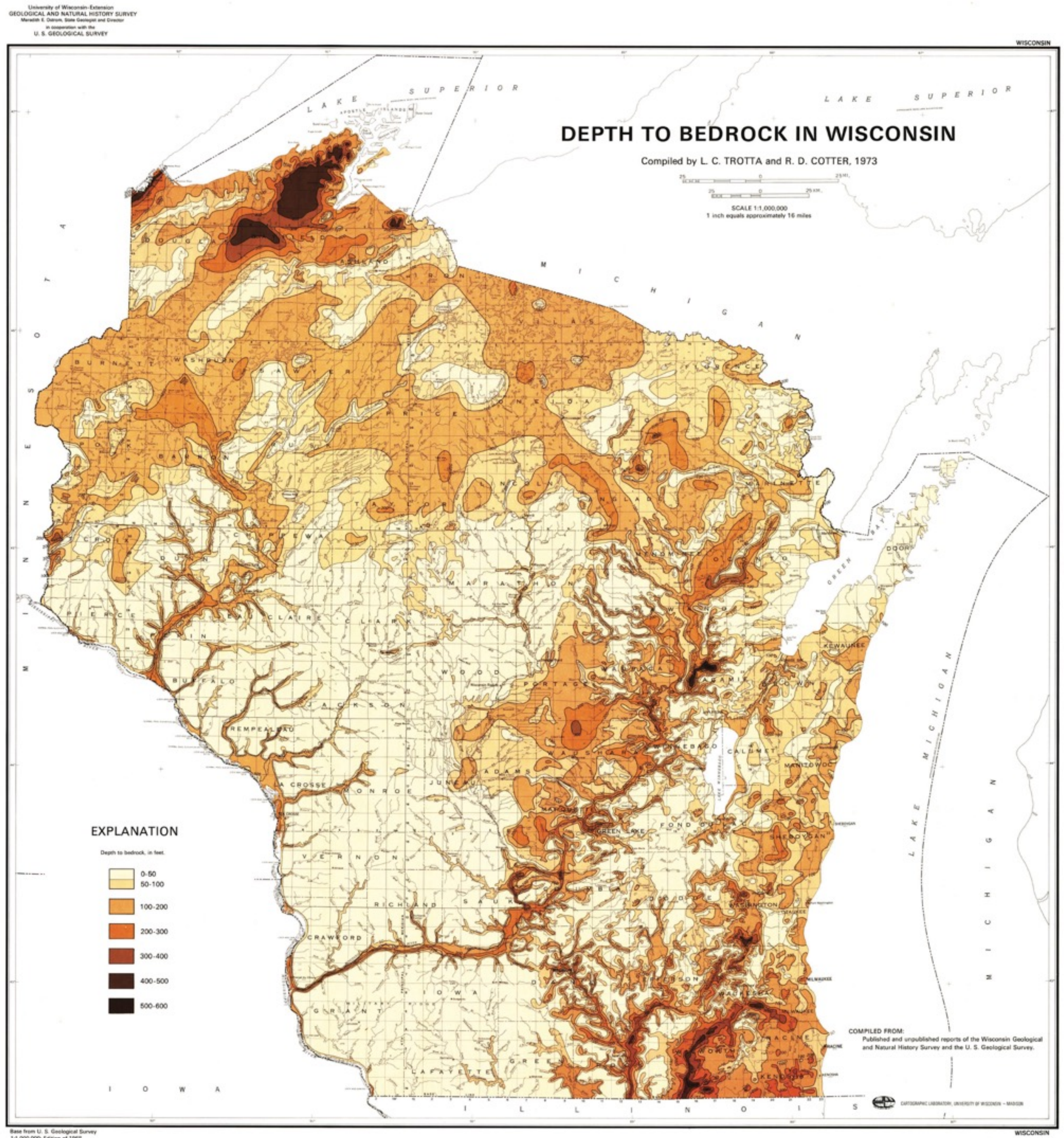

State of Wisconsin
Department of Natural Resources
WELL CONSTRUCTOR'S REPORT
COUNTY Kewaunee
Lincoln
Jeff Pelnar
Route 1
Algoma, Wis. 54201
Mobile Home
Clay & gravel
Lime Rock
New black steel
Mud
Aug. 27
Oct. 26
Madison
Brussels, Wis. 54204




Steve Mauel - WGNHS

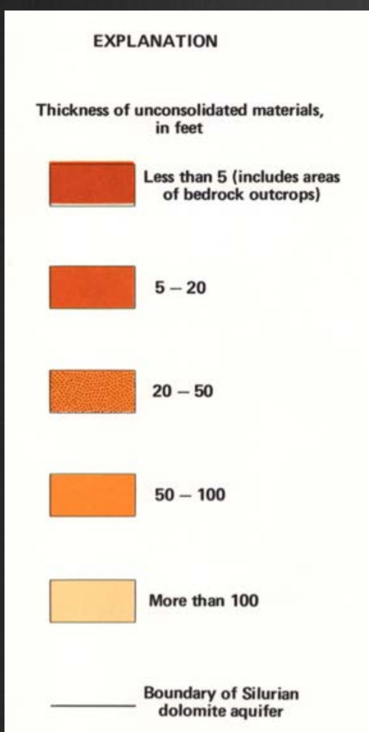
Published Maps

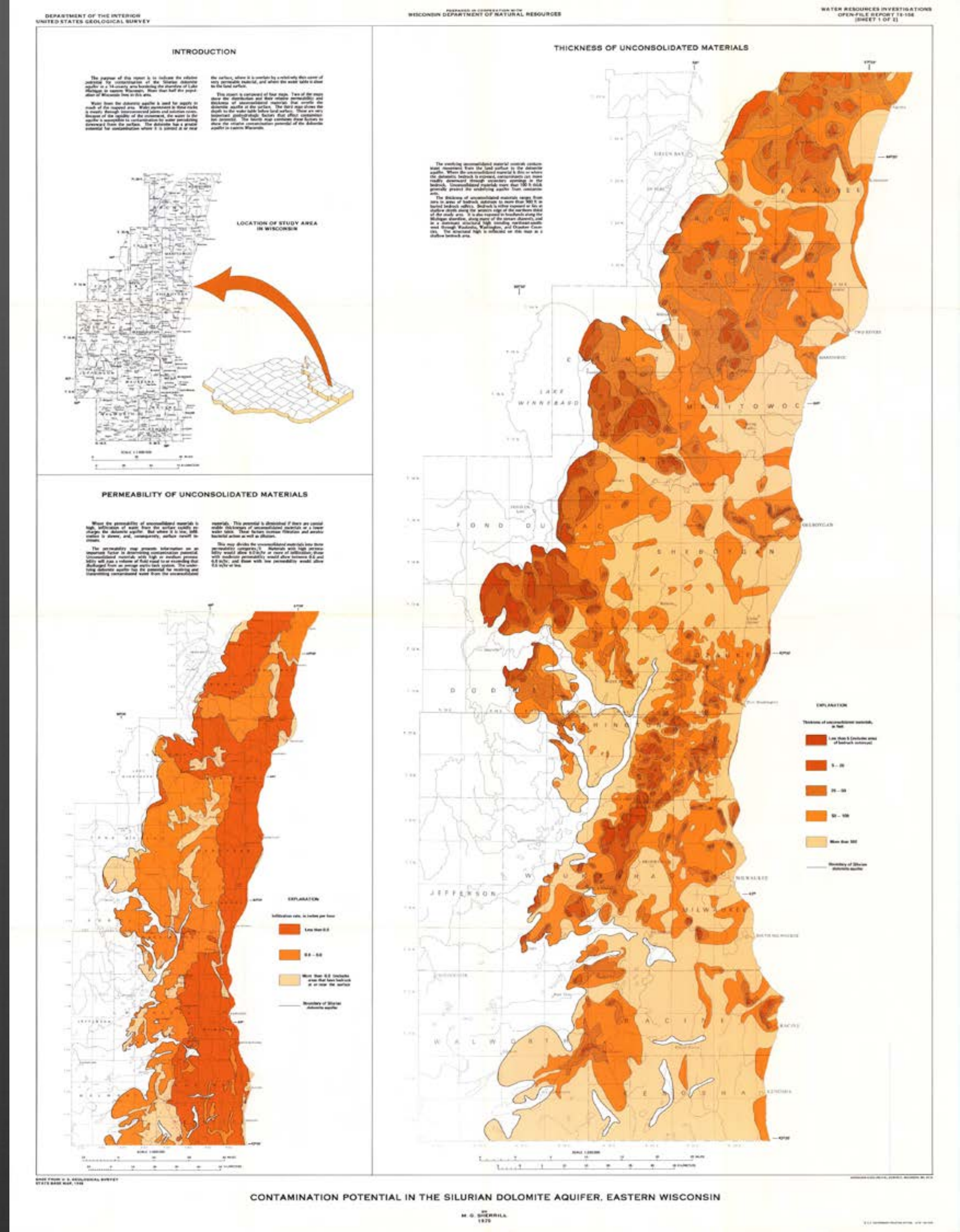
Statewide:
Trotta and Cotter
Published 1973



Published Maps

Regional:
USGS Open File Report 78-108
Sherrill 1979

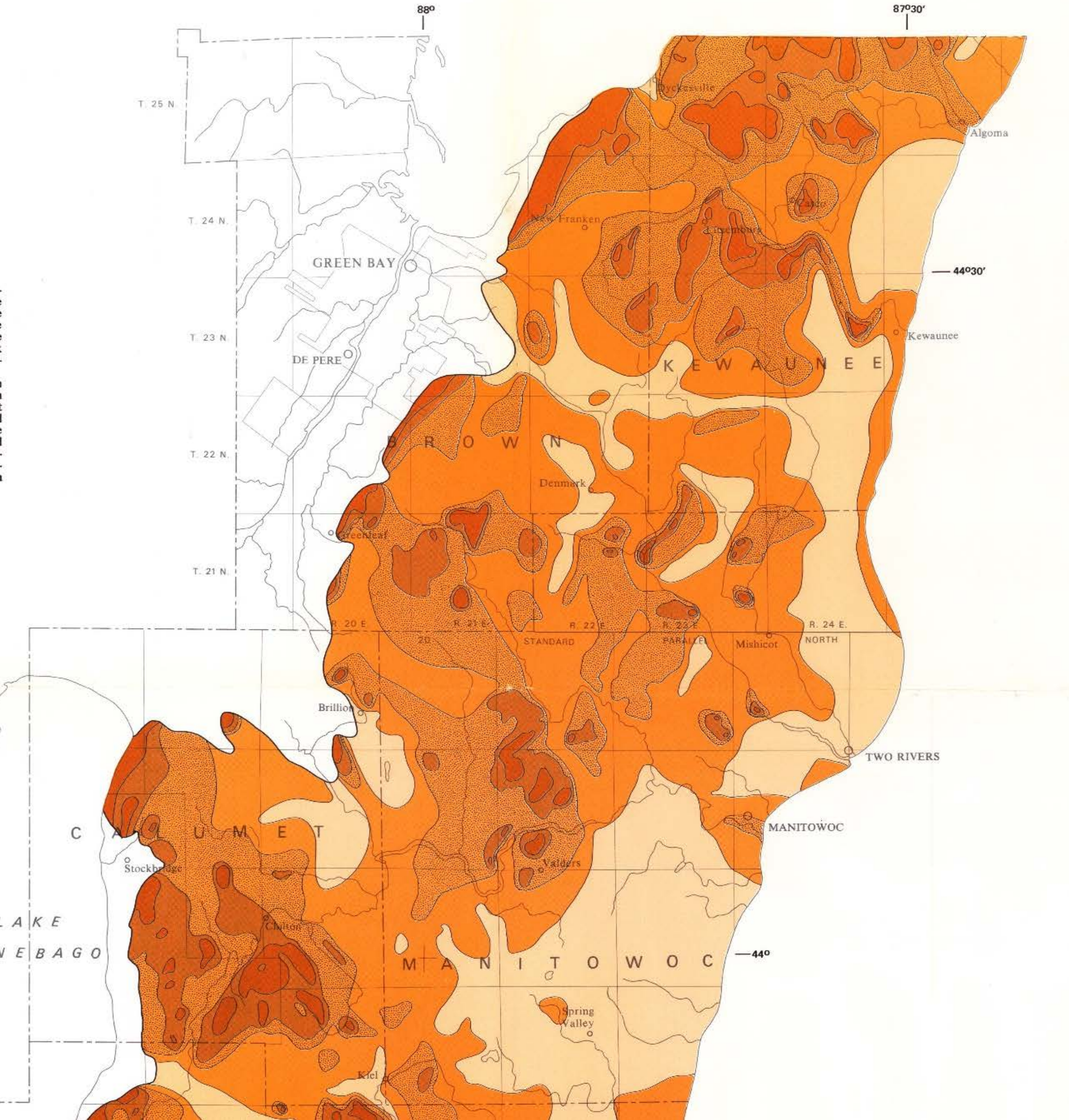




THICKNESS OF UNCONSOLIDATED MATERIALS

The overlying unconsolidated material controls contaminant movement from the land surface to the dolomite aquifer. Where the unconsolidated material is thin or where the dolomitic bedrock is exposed, contaminants can move readily downward through secondary openings in the bedrock. Unconsolidated materials more than 100 ft thick generally protect the underlying aquifer from contaminants.

The thickness of unconsolidated materials ranges from zero in areas of bedrock outcrops to more than 500 ft in buried bedrock valleys. Bedrock is either exposed or lies at shallow depth along the western edge of the northern third of the study area. It is also exposed in headlands along the Michigan shoreline, along many of the stream channels, and in a dominant structural high trending northeast-southwest through Waukesha, Washington, and Ozaukee Counties. The structural high is reflected on this map as a shallow bedrock area.



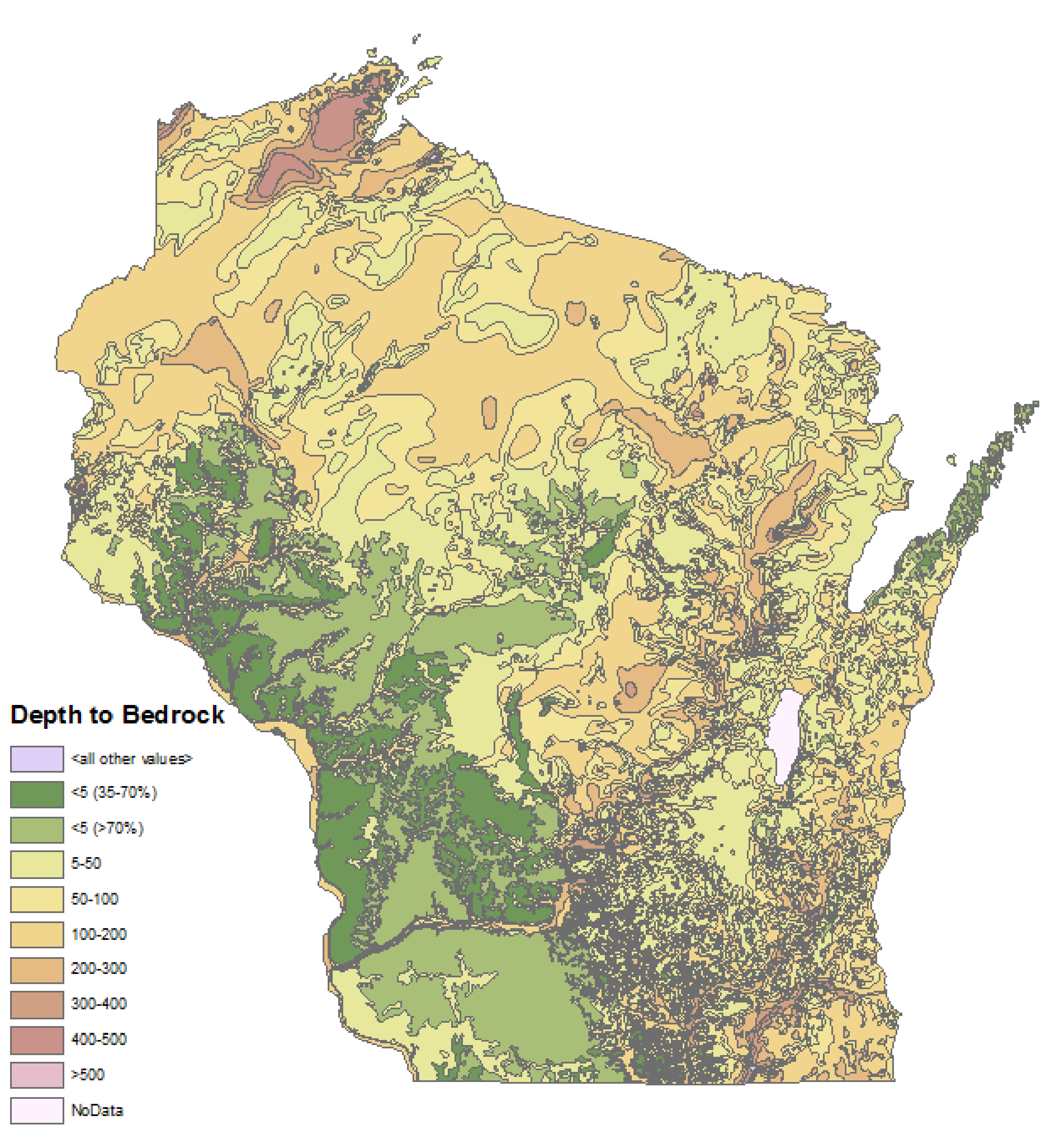
EXPLANATION

Thickness of unconsolidated materials, in feet

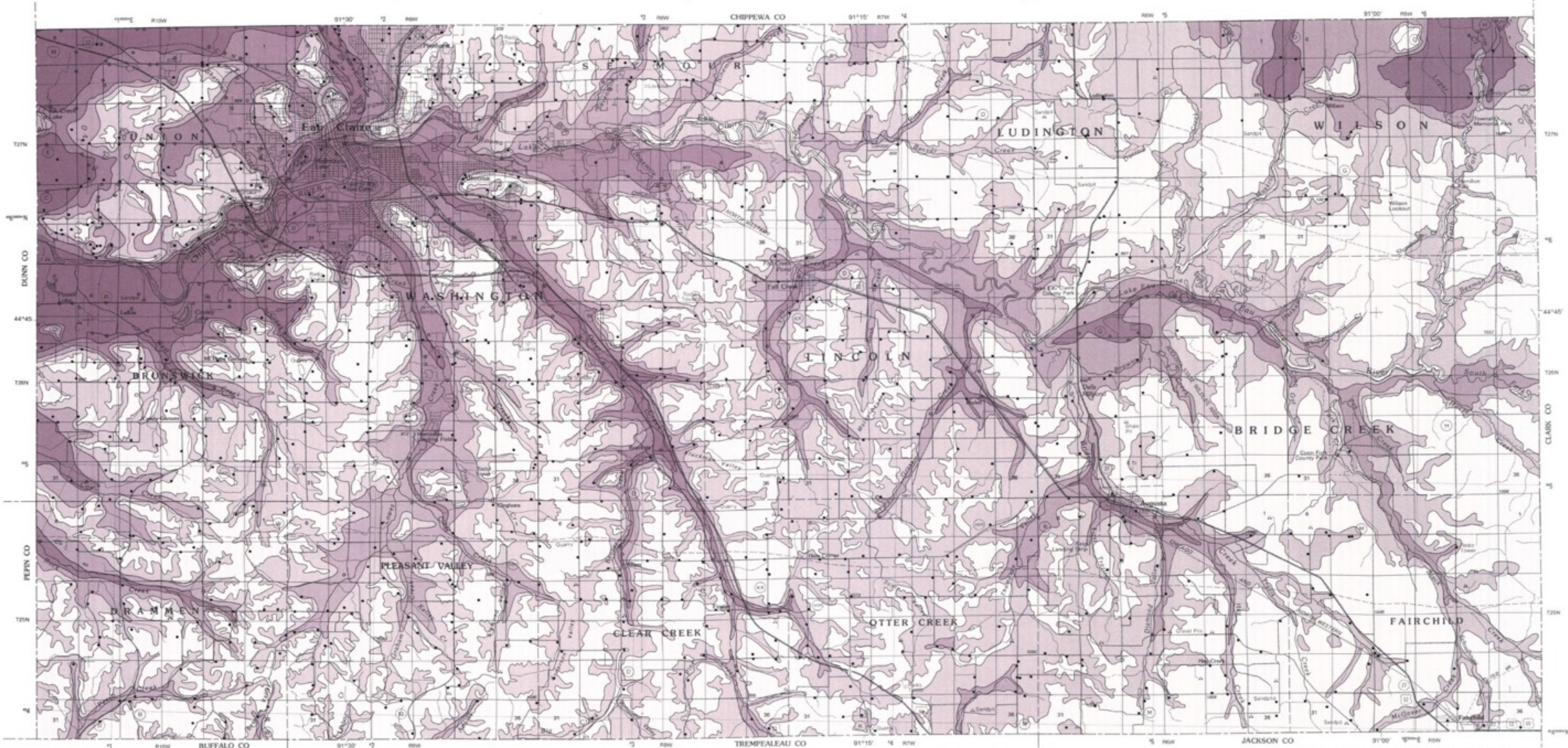
- Less than 5 (includes areas of bedrock outcrops)
- 5 – 20
- 20 – 50
- 50 – 100
- More than 100
- Boundary of Silurian dolomite aquifer

Maps

Statewide
This map is is compiled from two maps:
1. Groundwater Contamination Susceptibility in Wisconsin" depth to bedrock map
2. Previously shown Trotta and Cotter map.

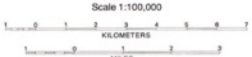


Depth to Bedrock Map of Eau Claire County, Wisconsin



Base map from U.S. Geological Survey County Map Series (Topographic), 1985.

Scale 1:100,000



Cartography by D.L. Patterson and D.C. Endrizzi

D.M. Johnson, 1993

Miscellaneous Map 37

A product of the Eau Claire County Groundwater Resource Investigation, a joint project of the Wisconsin Geological and Natural History Survey and the Eau Claire County Board of Supervisors.

Depth to bedrock categories

0–5 ft	bedrock at or near the land surface
5–25 ft	bedrock often exposed in roadcuts, streambeds, and excavations
25–50 ft	bedrock usually intersected by water wells and other borings
50–100 ft	bedrock intersected only by deep drillholes
100+ ft	bedrock intersected only by deep drillholes

approximate depth to bedrock, in feet below land surface

∘ well that does not intersect bedrock • well that intersects bedrock

In Eau Claire County, bedrock is composed almost entirely of Cambrian sandstone, siltstone, and small amounts of shale. The Mount Simon Formation of the Elk Mound Group is the most extensively exposed unit. Cambrian rock is absent in the stream valleys of the northeast, where Precambrian basement rock is exposed, and is up to more than 250 feet thick in the southwest part of the county. In the hills of southern Eau Claire County, the Mount Simon is overlain by younger Cambrian sandstone, dolomite, and shale of the Elk Mound Group (the Eau Claire and Wonewoc Formations), the Tunnel City Group, and the St. Lawrence and Jordan Formations of the Trempealeau Group. The strata dip gently to the southwest.

Surficial deposits in Eau Claire County, which are up to 200 feet thick in the Chippewa River valley and absent in places in upland areas where bedrock occurs at the surface, consist primarily of residuum and materials of glacial and alluvial origin. Three glacial episodes have deposited surficial materials in Eau Claire County: the pre-Illinois, Illinois, and Wisconsin (oldest to youngest) (Baker, 1984). Pre-Illinois lake sediment of the Kinnickinnic Member of the Pierce Formation was deposited in lakes that were dammed by ice that blocked the westward drainage of the Chippewa River and its tributaries; this material is absent in the uplands of the north and southwest and where it has been eroded. A red sandy till deposited in the northeastern part of the county during the Illinois Glaciation and derived from the Superior Basin is included in the River Falls Formation. During the Wisconsin Glaciation, the Laurentide Ice Sheet advanced into the northeastern corner of the county, where it deposited till and outwash.

Since glaciation, slope processes have reworked the glacial sediment as well as residual materials on bedrock. This reworking of sediment has resulted in the accumulation of colluvial deposits at the base of slopes. Figure 1 shows a cross section of a typical stream valley and the relationship of the bedrock to surficial deposits.

The depth to bedrock map presented here provides a general guide to the thickness of surficial materials. It is based on well records, the Eau Claire County soil survey (Soil Conservation Service, 1977), and field observations. The distribution of surficial deposits combined with the effects of erosion and mass wasting can cause significant differences in the depth to bedrock over short distances. Because of local complexity, this map should be used only as a guide to the general thickness of the materials. Detailed site-specific investigations, including drilling, are necessary to verify local conditions.

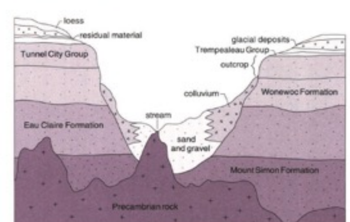


Figure 1. Cross section of typical stream valley.

Sources of information

Baker, R.W., 1984, Pleistocene history of west-central Wisconsin: Wisconsin Geological and Natural History Survey Field Trip Guide Book 11, 76 p.

Brown, B.A., 1988, Bedrock geology of Wisconsin, west-central sheet: Wisconsin Geological and Natural History Survey Map 88-7, scale 1:250,000.

Cates, K.J., and Madison, F.W., 1989, Soils of Eau Claire County, Wisconsin, and their ability to attenuate contaminants: Wisconsin Geological and Natural History Survey Map 89-6, scale 1:100,000.

Mudrey, M.G., Jr., ed., 1978, Upper Mississippi Valley base-metal district: Wisconsin Geological and Natural History Survey Field Trip Guide Book 1, 39 p.

Soil Conservation Service, 1977, Soil survey of Eau Claire County, Wisconsin: U.S. Department of Agriculture, 144 p. plus maps, scale 1:15,840.

Wisconsin Department of Natural Resources well constructor's reports (1931–87).

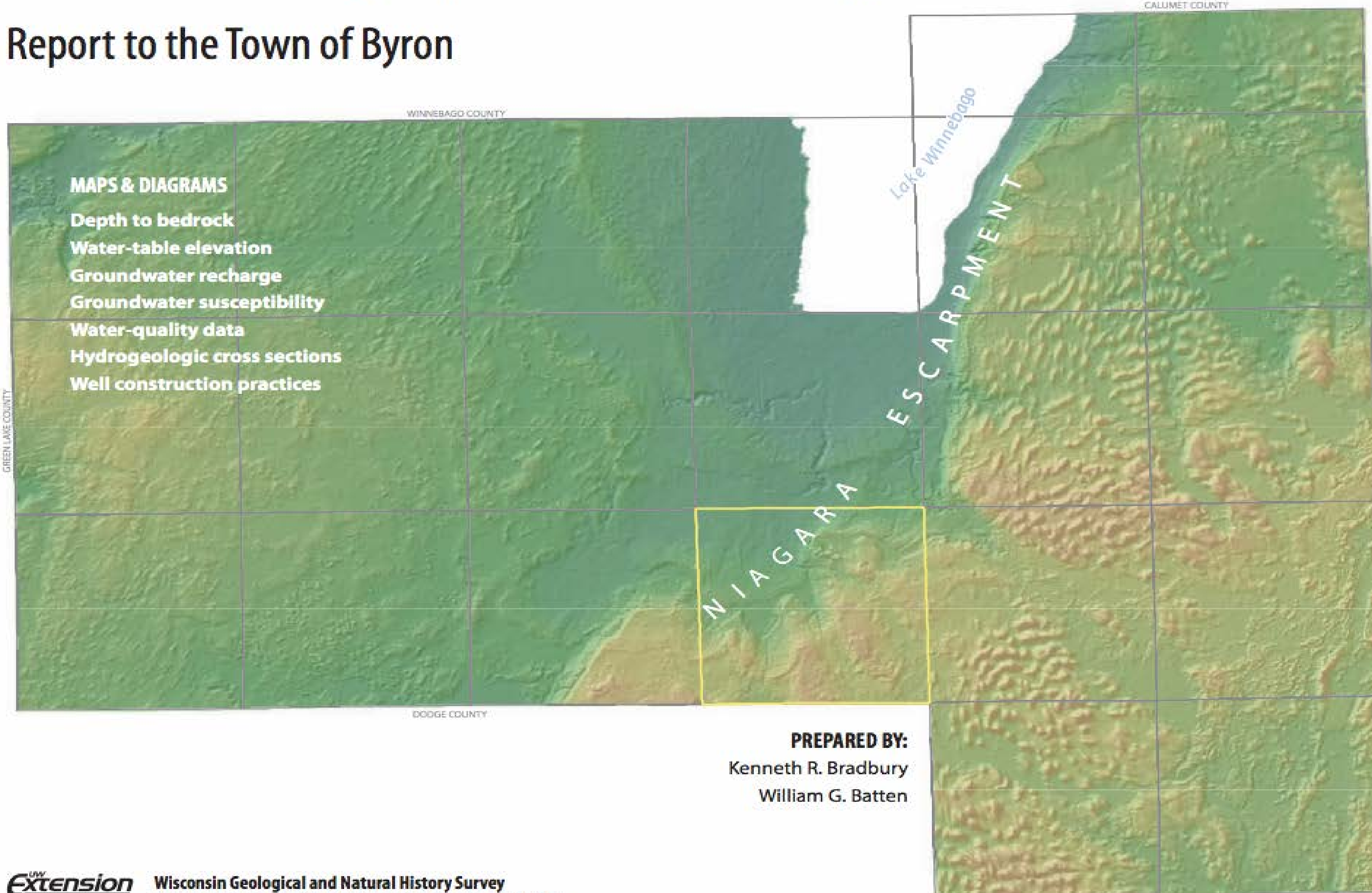
Wisconsin Geological and Natural History Survey published and unpublished geologic logs (1896–1988).

Published by and available from

UWEX GNHS
University of Wisconsin–Extension
Wisconsin Geological and Natural History Survey
3817 Mineral Point Road • Madison, Wisconsin 53705-5100
TELEPHONE 608/263.7389 FAX 608/262.8086
James M. Robertson, Director and State Geologist

Groundwater susceptibility maps and diagrams for the Town of Byron, Fond du Lac County, Wisconsin

Report to the Town of Byron



MAPS & DIAGRAMS

- Depth to bedrock
- Water-table elevation
- Groundwater recharge
- Groundwater susceptibility
- Water-quality data
- Hydrogeologic cross sections
- Well construction practices

PREPARED BY:

Kenneth R. Bradbury

William G. Batten

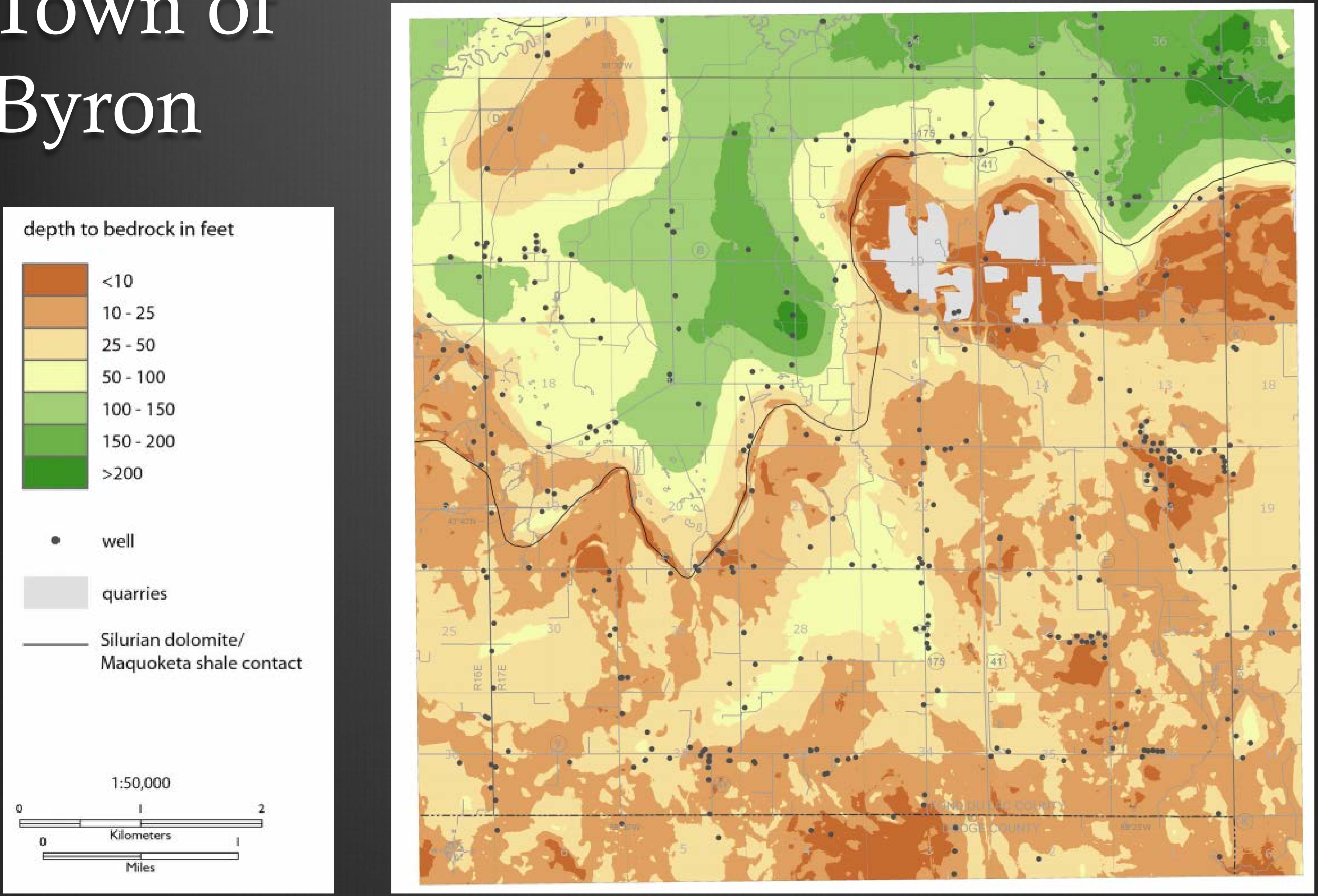
UW Extension Cooperative Extension

Wisconsin Geological and Natural History Survey

3817 Mineral Point Rd., Madison, WI 53705 • WisconsinGeologicalSurvey.org

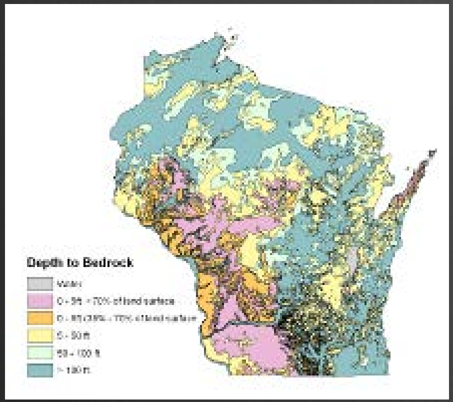
March 2010

Town of Byron

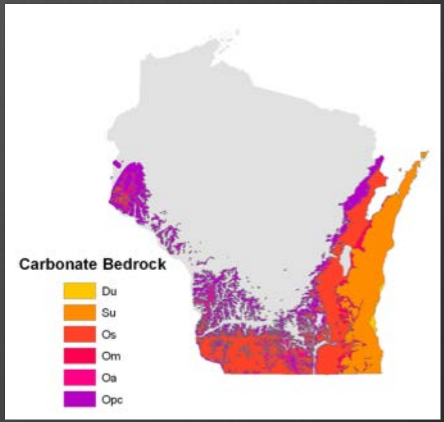


Karst Potential Map

combines geology and depth to bedrock

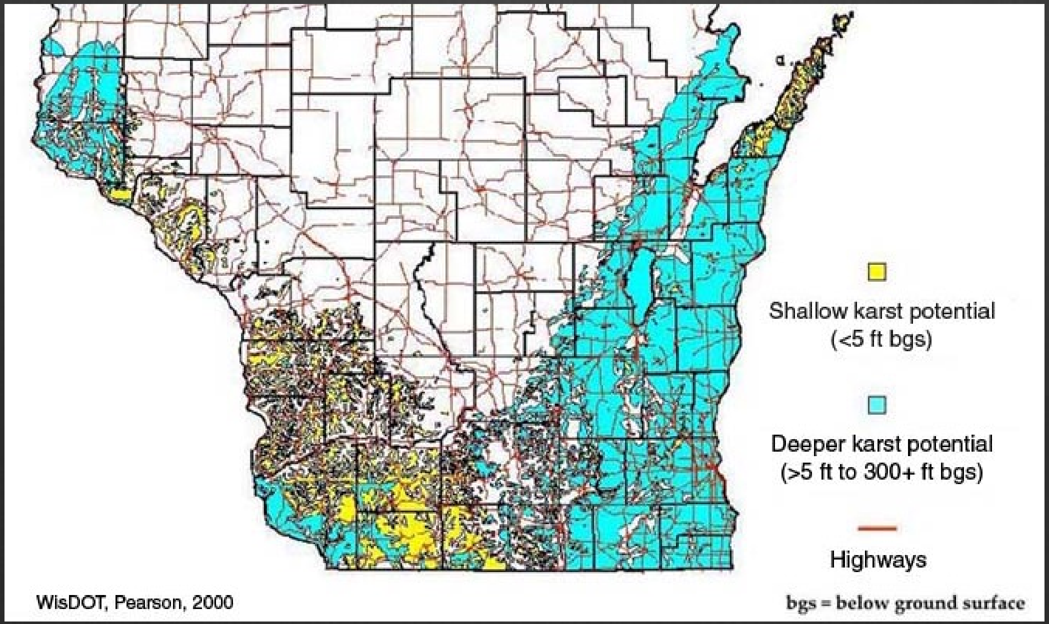


Depth to bedrock



Carbonate Bedrock

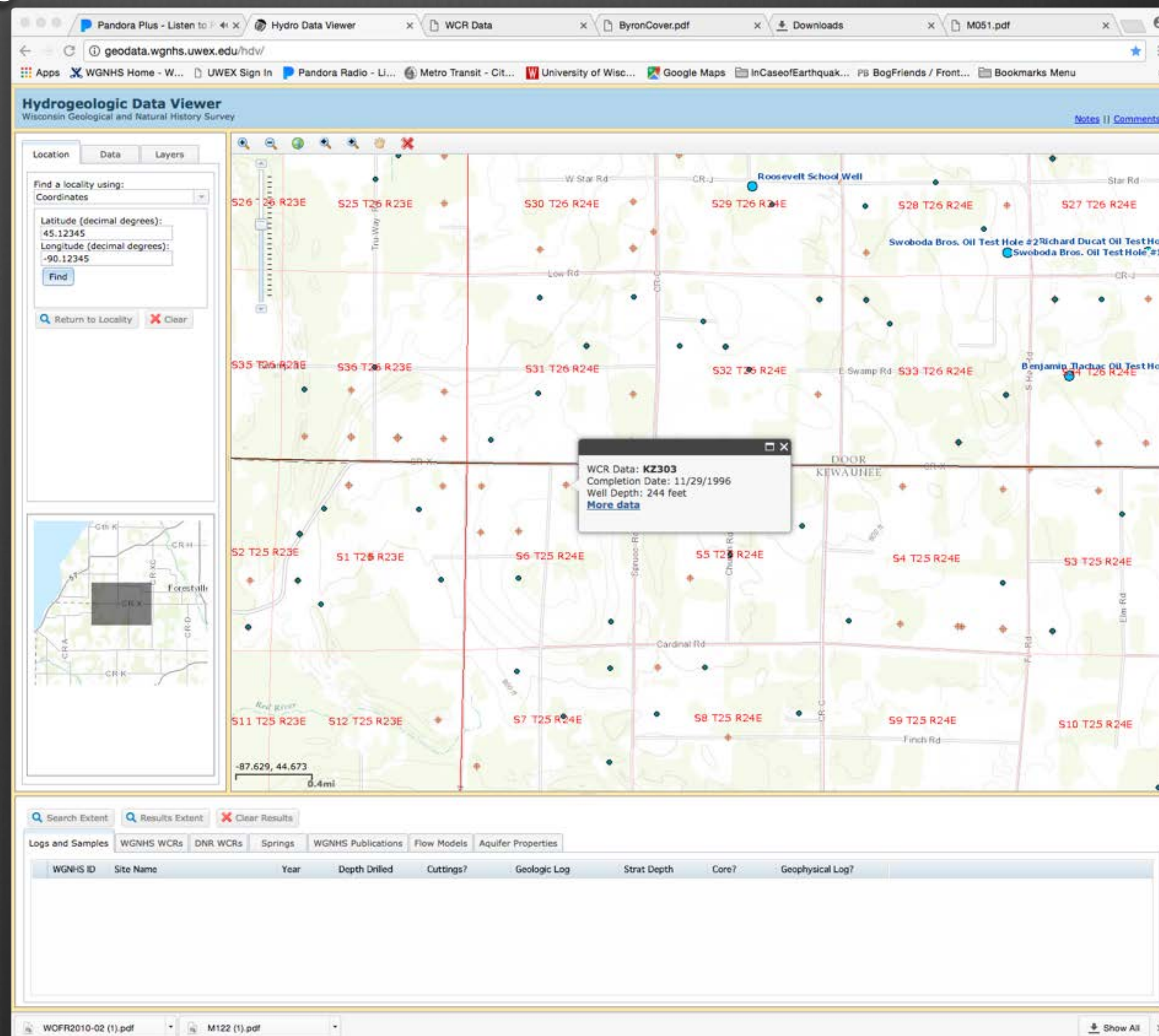
Wisconsin's shallow karst potential map



Well Construction Reports and HydroDataviewer

Online Web GIS

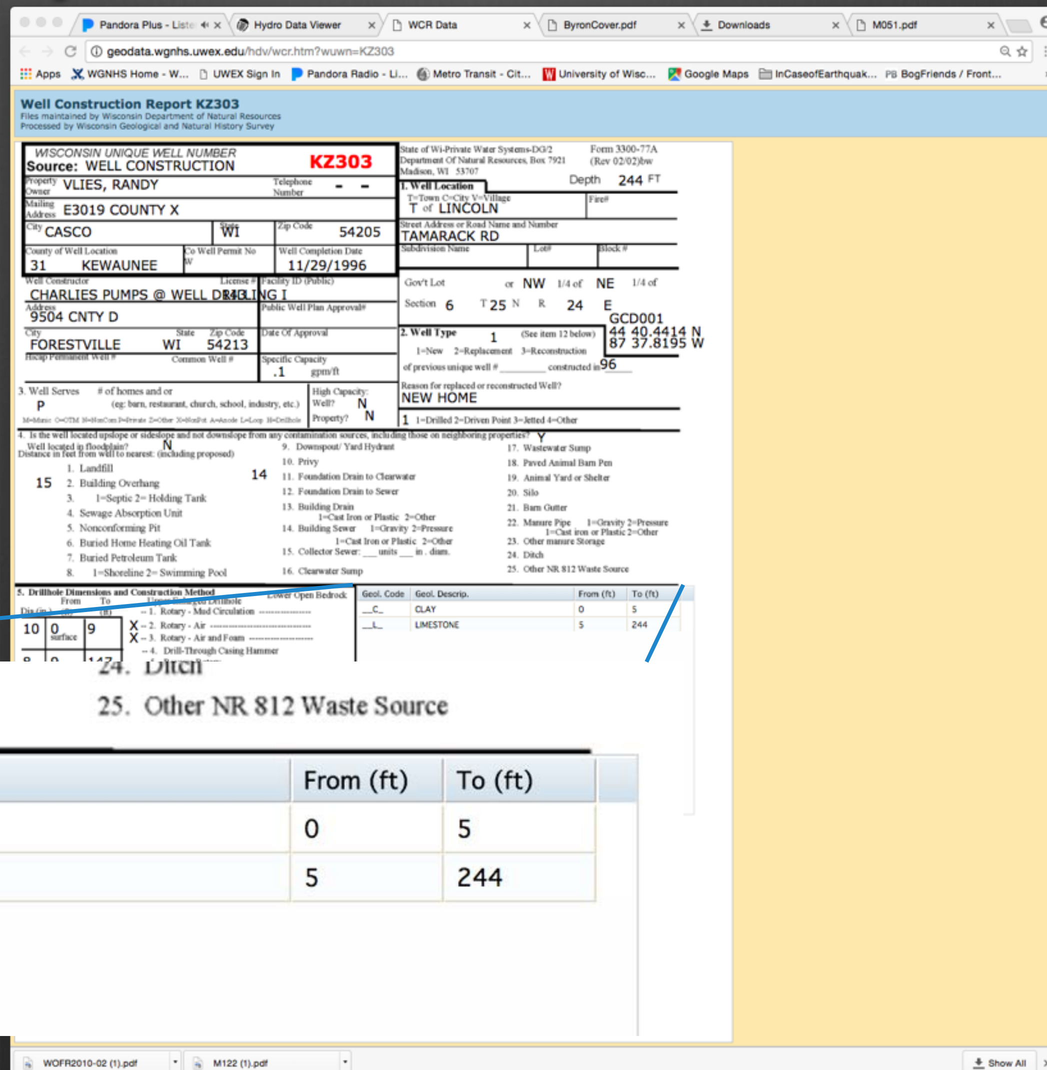
Search for individual wells for spot depths to bedrock.



Well Construction Reports and HydroDataviewer

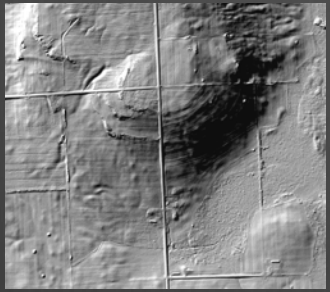
Online Web GIS

Search for individual wells for spot depths to bedrock.



Methods

- Well logs
- Physical
  - Backhoe
  - Geoprobe
  - Push rod
  - Drill Rig
- LIDAR



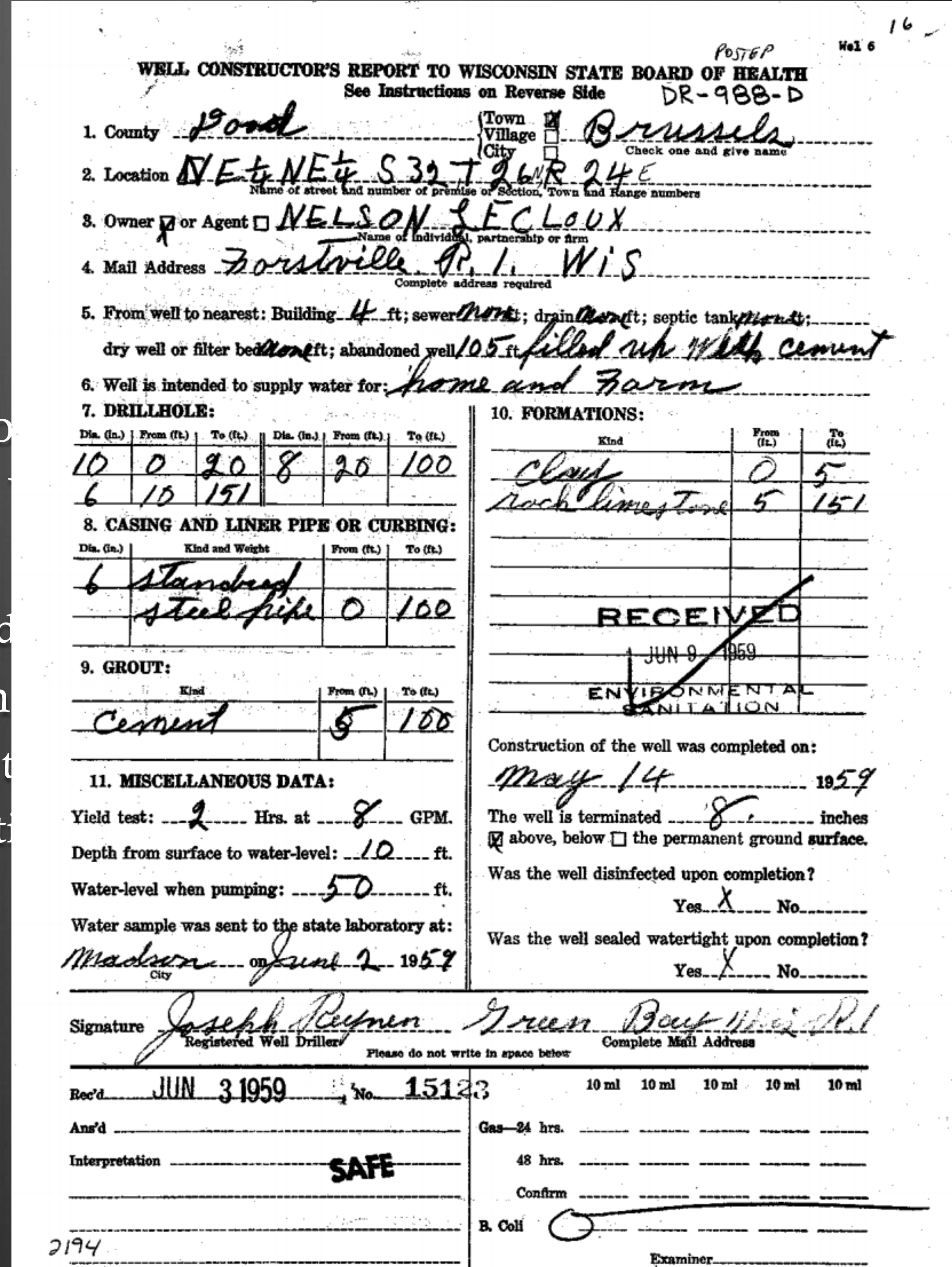
- Geophysics
  - Passive Seismic

  - Electrical Resistivity Imaging

  - Refraction Seismic
  - Ground Penetrating Radar

Methods

- Well Log Data
  - Most Basic
  - Well Construction Repo
    - Reported by drillers to
  - Geologic Logs
    - higher quality – studied
  - Needs to located and ch
    - Historically located to t
    - Descriptions are someti



16

Wel 6

POSTEP

WELL CONSTRUCTOR'S REPORT TO WISCONSIN STATE BOARD OF HEALTH
See Instructions on Reverse Side

DR-988-D

1. County Door — Town ☒ Village ☐ City ☐ Brussels (Check one and give name)
2. Location NE¼ NE¼ S32 T26N R24E (Name of street and number of premise or Section, Town and Range numbers)
3. Owner ☒ or Agent ☐ NELSON LECLOUX (Name of individual, partnership or firm)
4. Mail Address Forstville R. 1. Wis (Complete address required)
5. From well to nearest: Building 4 ft; sewer none ft; drain none ft; septic tank none ft; dry well or filter bed none ft; abandoned well 105 ft filled up with cement
6. Well is intended to supply water for: home and Farm

7. DRILLHOLE:

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
10	0	20	8	20	100
6	10	151			

8. CASING AND LINER PIPE OR CURBING:

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
6	standard steel pipe	0	100

9. GROUT:

Kind	From (ft.)	To (ft.)
Cement	5	100

10. FORMATIONS:

Kind	From (ft.)	To (ft.)
clay	0	5
rock limestone	5	151

RECEIVED JUN 9 1959 ENVIRONMENTAL SANITATION

Construction of the well was completed on: May 14 1959

The well is terminated 8 inches ☒ above, below ☐ the permanent ground surface.

Was the well disinfected upon completion? Yes X No

Was the well sealed watertight upon completion? Yes X No

11. MISCELLANEOUS DATA:

Yield test: 2 Hrs. at 8 GPM.

Depth from surface to water-level: 10 ft.

Water-level when pumping: 50 ft.

Water sample was sent to the state laboratory at: Madison (City) on June 2 1959

Signature Joseph Reynen (Registered Well Driller) Green Bay Wis R.1 (Complete Mail Address)

Please do not write in space below

Rec'd JUN 3 1959 No. 15123

10 ml 10 ml 10 ml 10 ml 10 ml

Ans'd

Gas—24 hrs.

Interpretation SAFE

48 hrs.

Confirm

B. Coli

Examiner

2194

Methods

- Physical
  - Backhoe
  - Geoprobe
  - Push rod
  - Drill Rig

  - Readily available
  - Point measurement instead of continuous
  - Push methods – refusal might underestimate depth
    - Hit rock in sediment rather than bedrock

Methods

LIDAR data – land surface elevation mapping

- Light Detection and Ranging
- High-resolution elevation mapping
- Evaluate bedrock features by elevation
- Use with other methods to identify larger areas of shallow bedrock

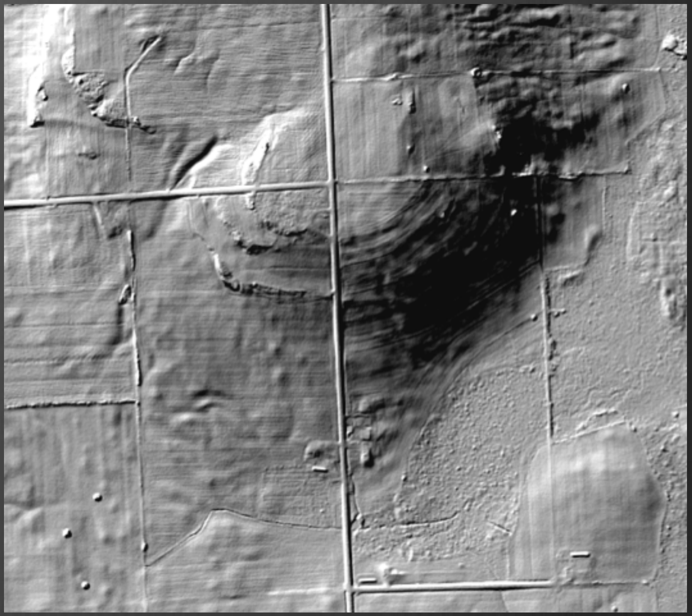
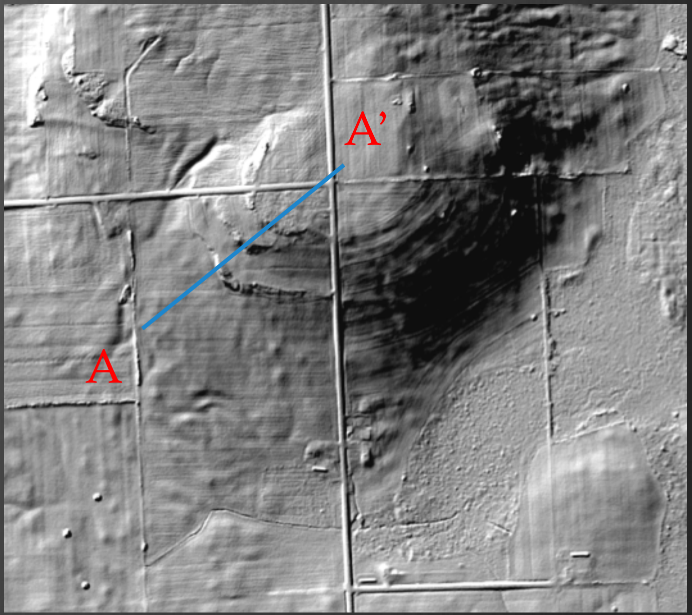
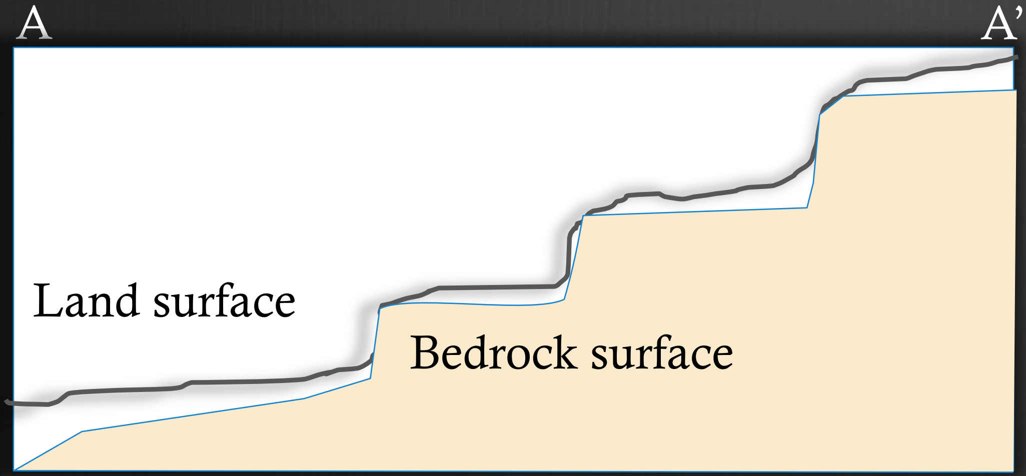


Illustration of a point data issue

Dolomite has layers
Planes of weakness





Results in scarps in the landscape. Create varying shallow depth to bedrock

Good model to keep in mind when using point data for depth to bedrock

Methods

- Geophysics
  - Pros and Cons
    - quick, (sometimes) continuous data, non-invasive, portable
    - doesn't always provide answer, non-unique, not enough accuracy, some training in acquisition and analysis, should have some verfication
    - We use
      - Passive Seismic
      - Electrical Resistivity Imaging
      - Refraction Seismic
      - Ground Penetrating Radar

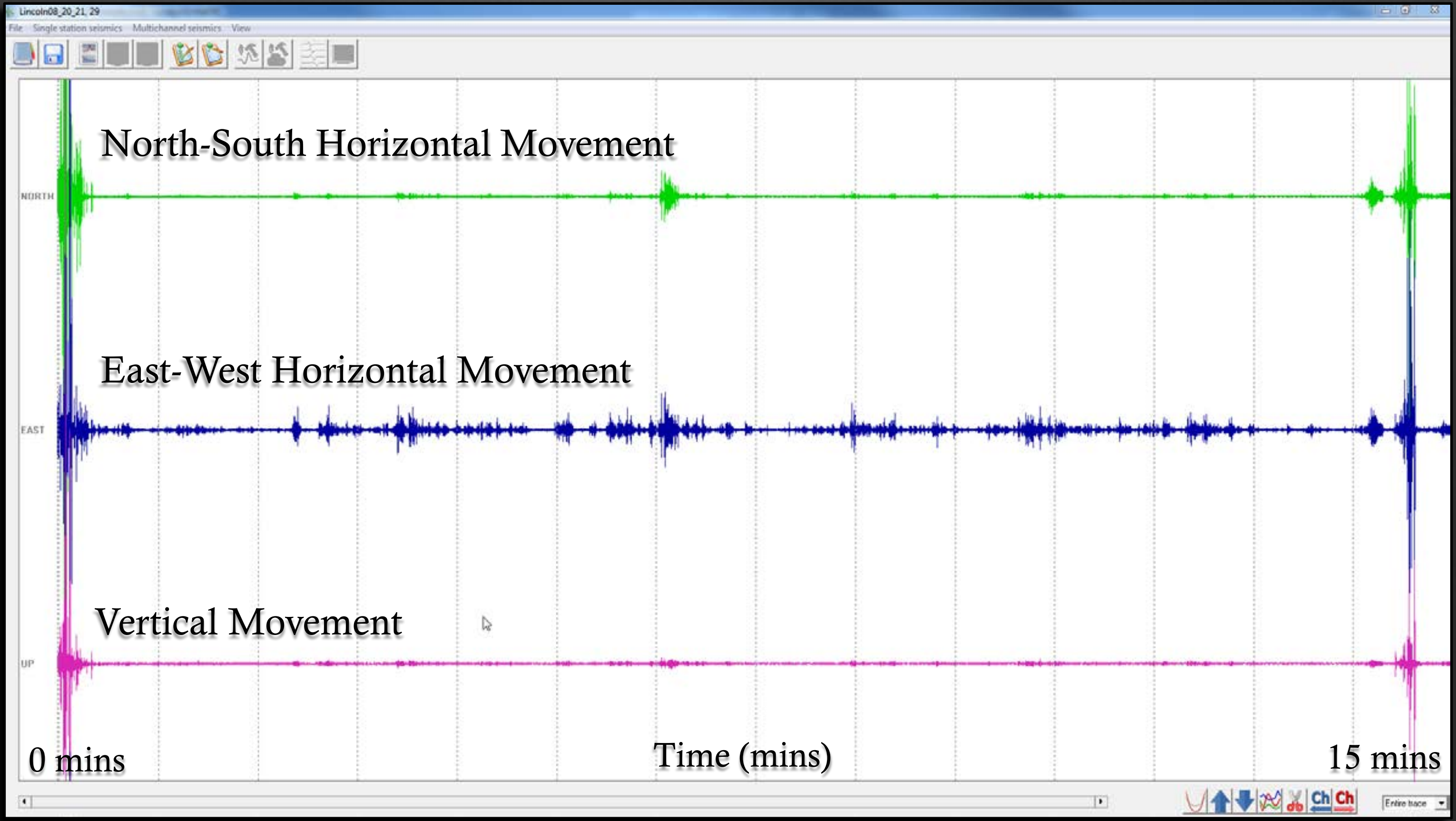
Passive Seismic

1. Set the instrument level on the ground for 15-20 mins.

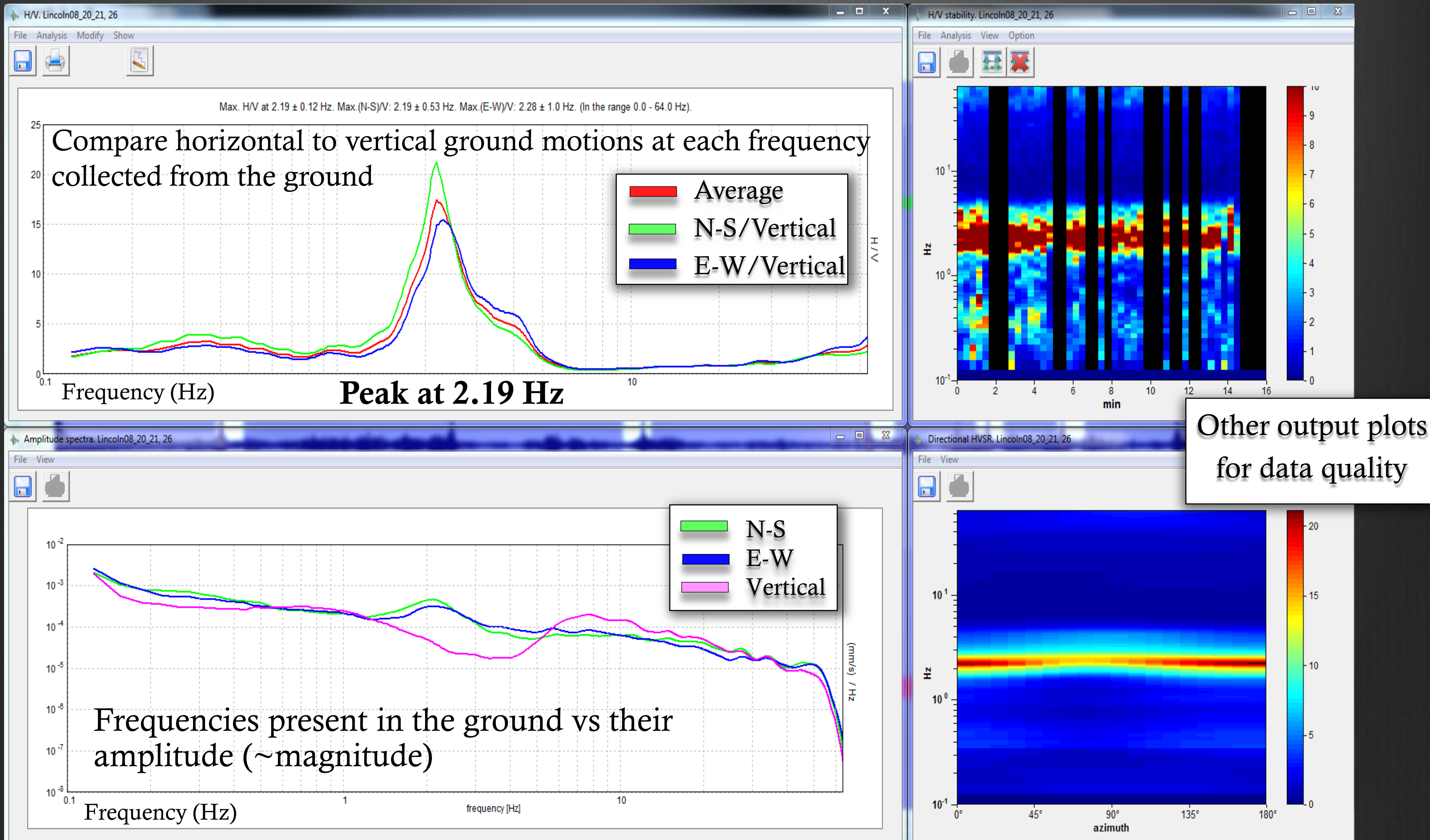
2. Instrument collects "passive" horizontal and vertical motions in the ground (traffic, lake waves, industry, trees in the wind)

Slide courtesy of Mike Parsen

The instrument collects horizontal and vertical ground motion



Slide courtesy of Mike Parsen



The dominant frequency, that shakes the sediment horizontally vs. vertically the most, is the resonant frequency of the sediment

This resonant frequency is inversely proportional to the sediment thickness → depth-to-bedrock estimate

Slide courtesy of Mike Parsen

Electrical Resistivity Imaging (ERI)

24 electrodes placed in ground in a line.

Current put into and out of an electrode pair. Voltage measured across another pair.

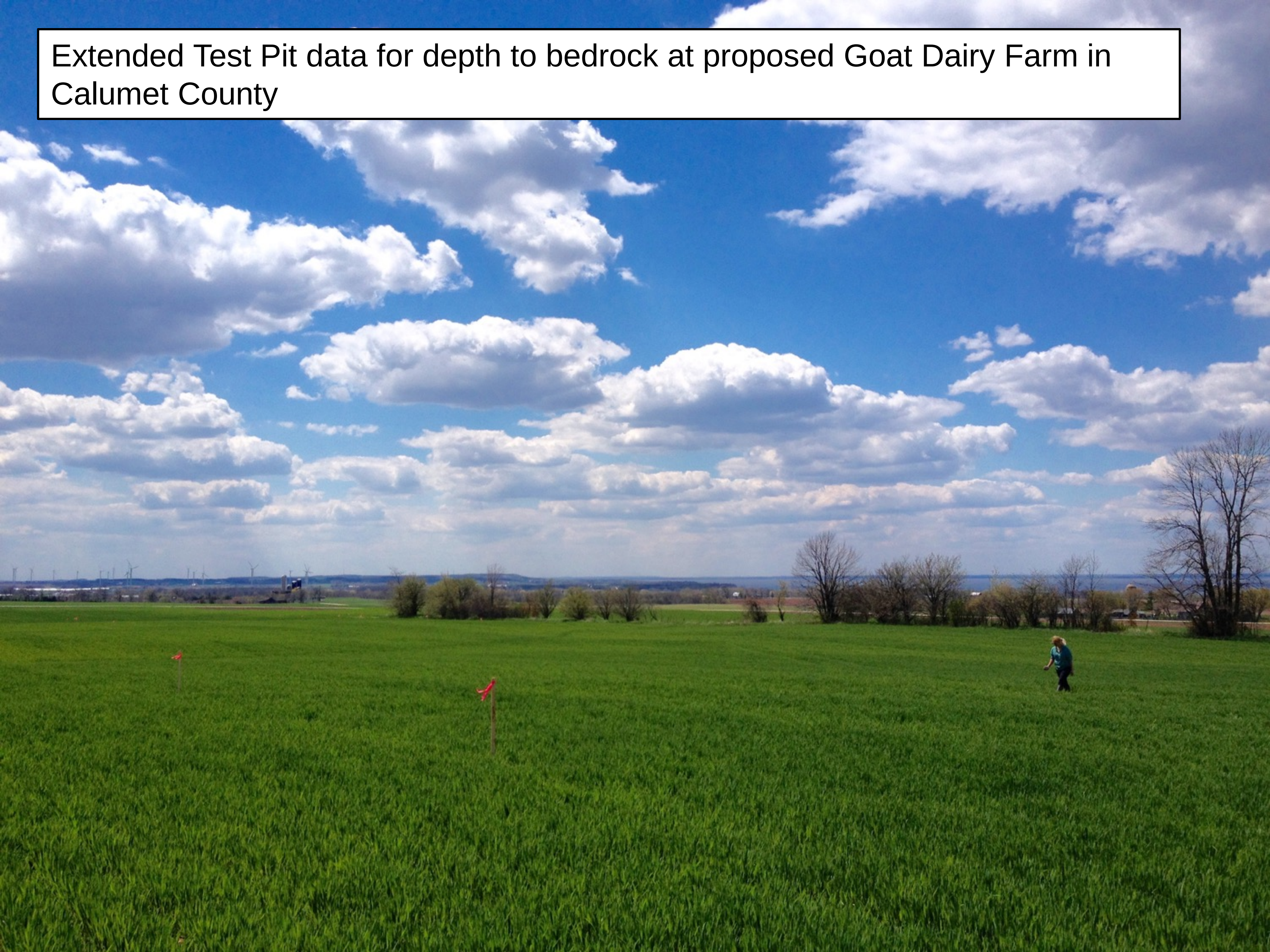
Diffrent sets of electrodes provides resistivity measurements at different depths and distances along the survey line

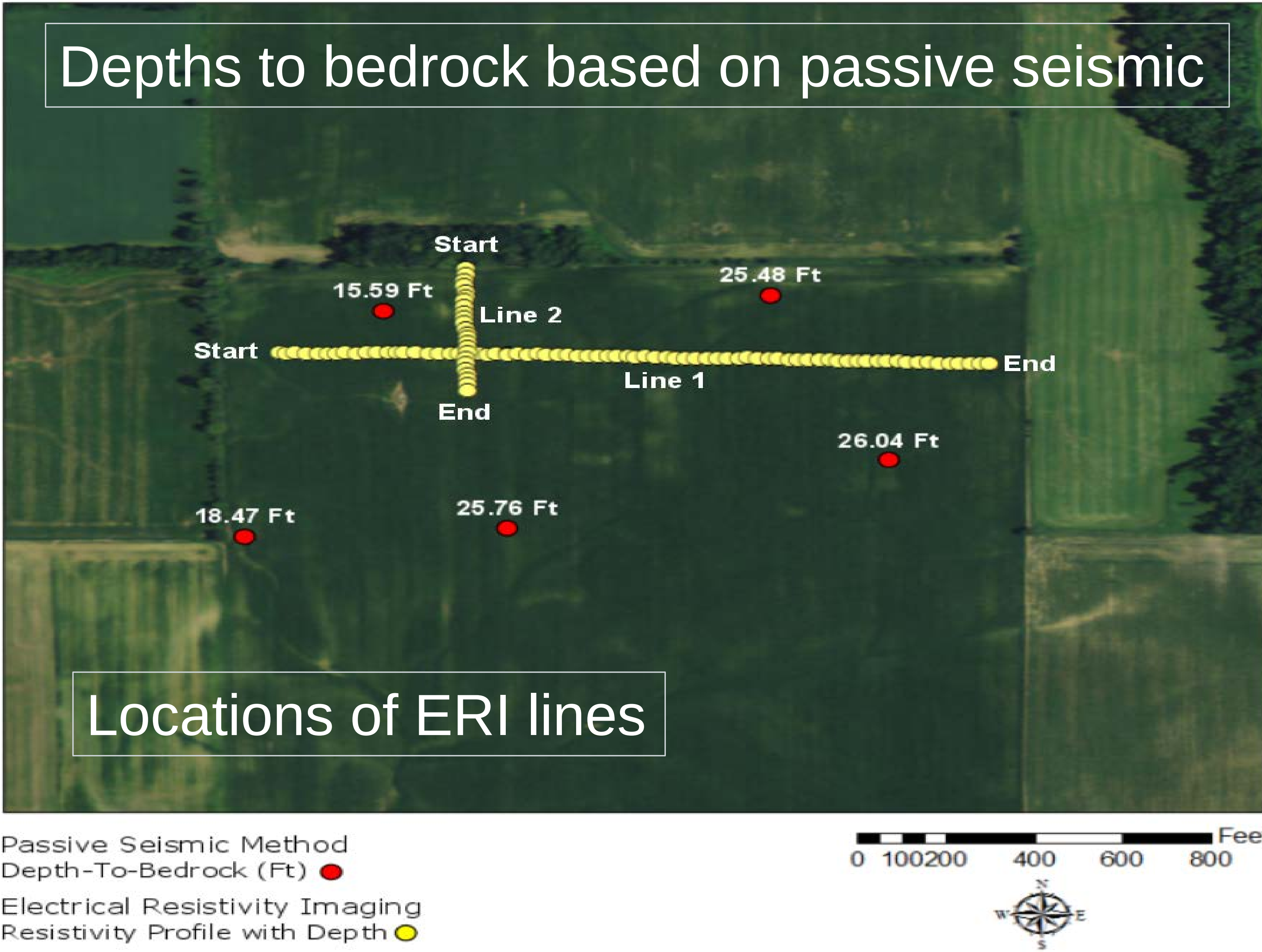
This creates a resistivity profile with depth along the line

Best in more conductive conditions (wet units and/or less competent rock)

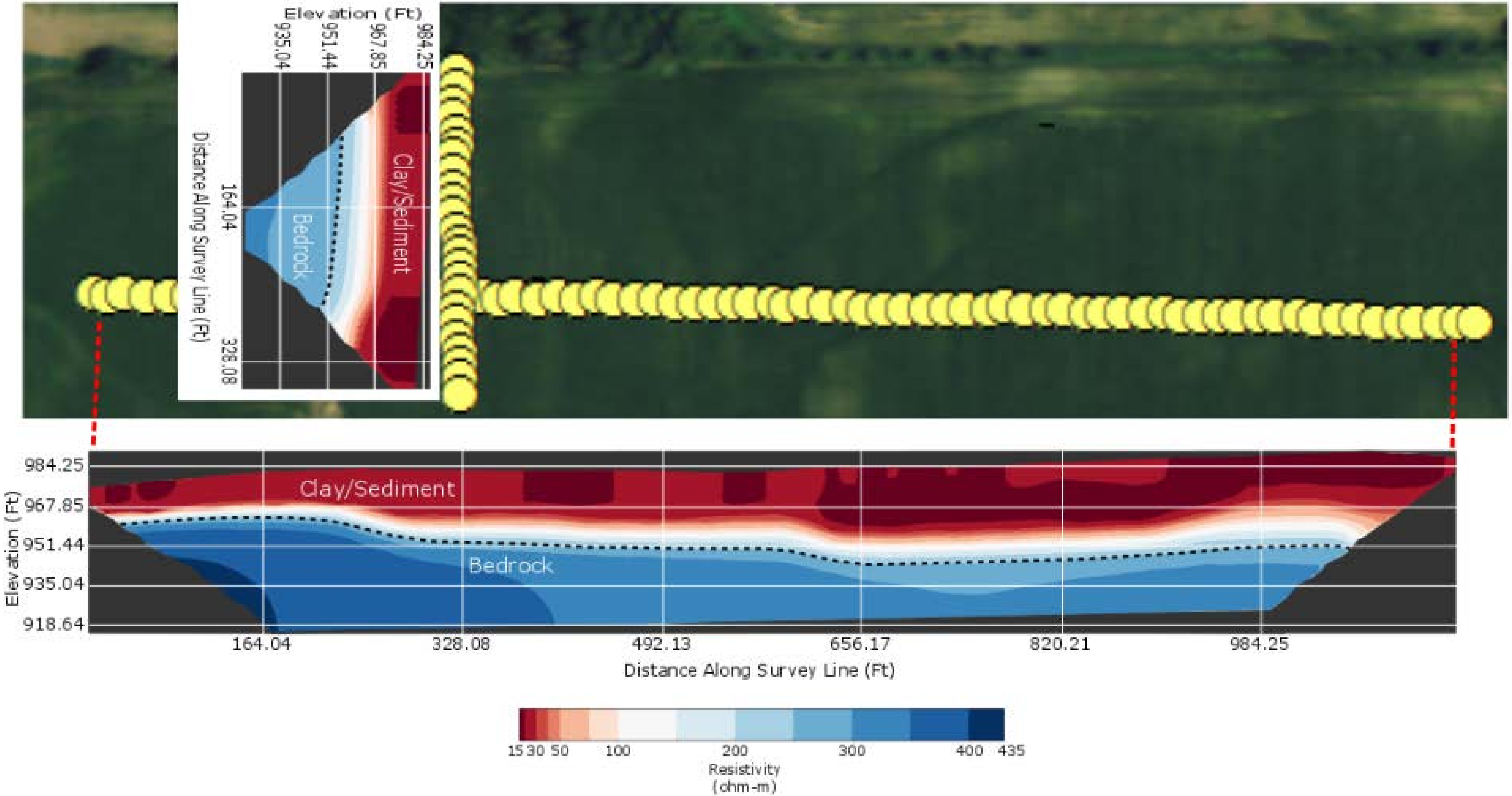
Slide courtesy of Mike Parsen

Extended Test Pit data for depth to bedrock at proposed Goat Dairy Farm in Calumet County




Depths to bedrock based on passive seismic
Start
15.59 Ft
Line 2
25.48 Ft
Start
End
Line 1
End
26.04 Ft
18.47 Ft
25.76 Ft
Locations of ERI lines
Passive Seismic Method
Depth-To-Bedrock (Ft)
Electrical Resistivity Imaging
Resistivity Profile with Depth
Feet
0 100200 400 600 800
N
W
E
S

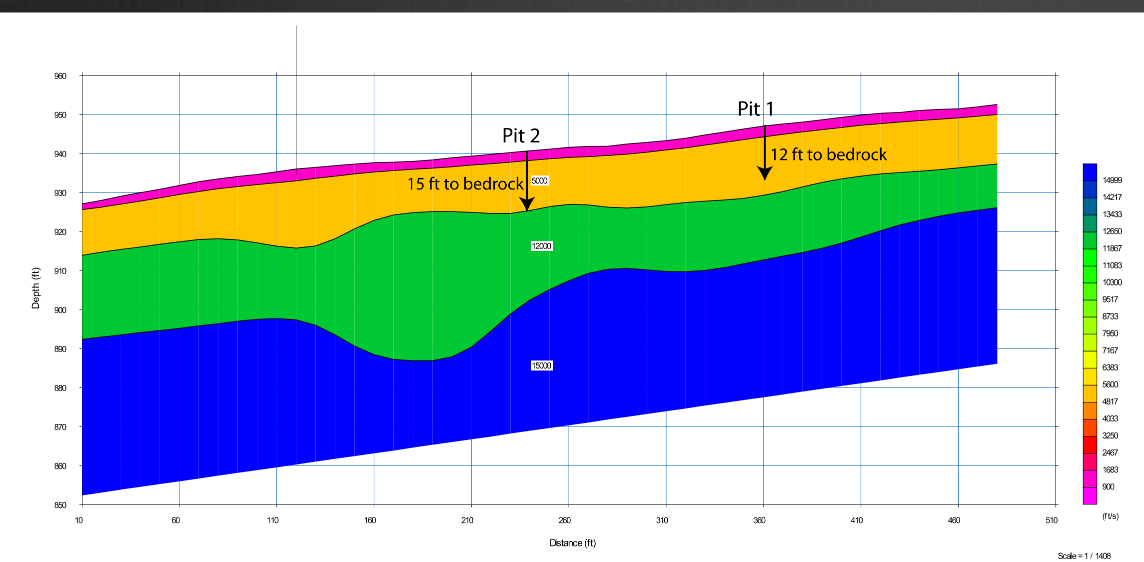
1000 foot line of depth to bedrock based on ERI data



Refraction Seismic

- Expensive and takes twice as long but gives good data
- Identified zone of weathered bedrock
- Indicated deeper bedrock than push methods.
- Verified by backhoe

Seismic Results from Gold Star Farms, Calumet Co.



http://www.uwdiscoveryfarms.org/UWDiscoveryFarms/media/sitecontent/PublicationFiles/mappingbedrock/Using-seismic-refraction-to-ID-vulnerable-landscape-factsheet.pdf?ext=.pdf

Ground Penetrating Radar (GPR)

Data Display and Survey Controls

Slide courtesy of Mike Parsen

Ground Penetrating Radar (GPR)

1. Radio waves are sent through the transmitter

2. The radio waves bounce off different subsurface layers

3. The radio waves return to the antenna's receiver

4. Radio wave travel times are converted to depths

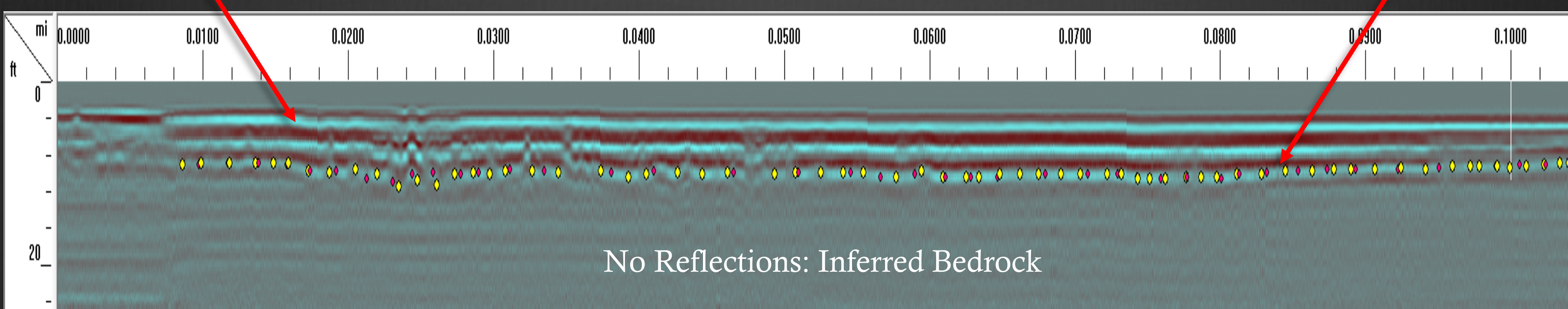
Slide courtesy of Mike Parsen

GPR image after processing

- Similar to an X-Ray at the doctor, except with radio waves
- When sediment or rock units vary in dielectric constant (strongly controlled by water content) a reflection is created
- The depth of radio wave (GPR) penetration into the ground is dependent on the conductivity of the subsurface

Sediment Layers

Top of Inferred Bedrock



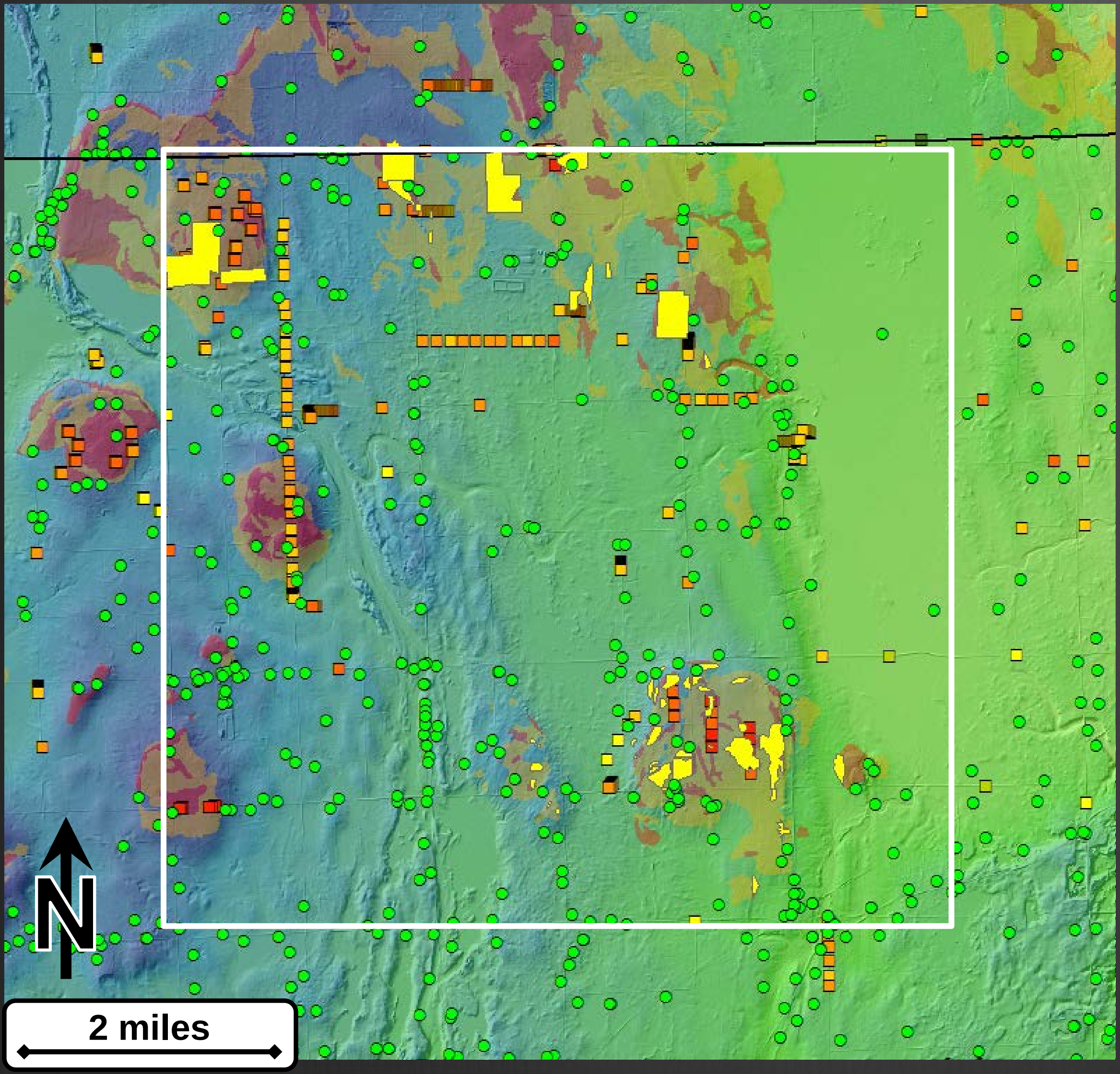
Hawk Rd between Fir Rd and Hwy P

Depth = Up to 20 m in some study areas

Slide courtesy of Mike Parsen

Putting it all together

Preliminary bedrock interpretation town of Lincoln



Consider all data inputs

- Well construction records
- Geophysics, borings, visual observations…
- NRCS soils map
- Farmer maps
- LIDAR elevation map

Slide courtesy of Mike Parsen

Questions?