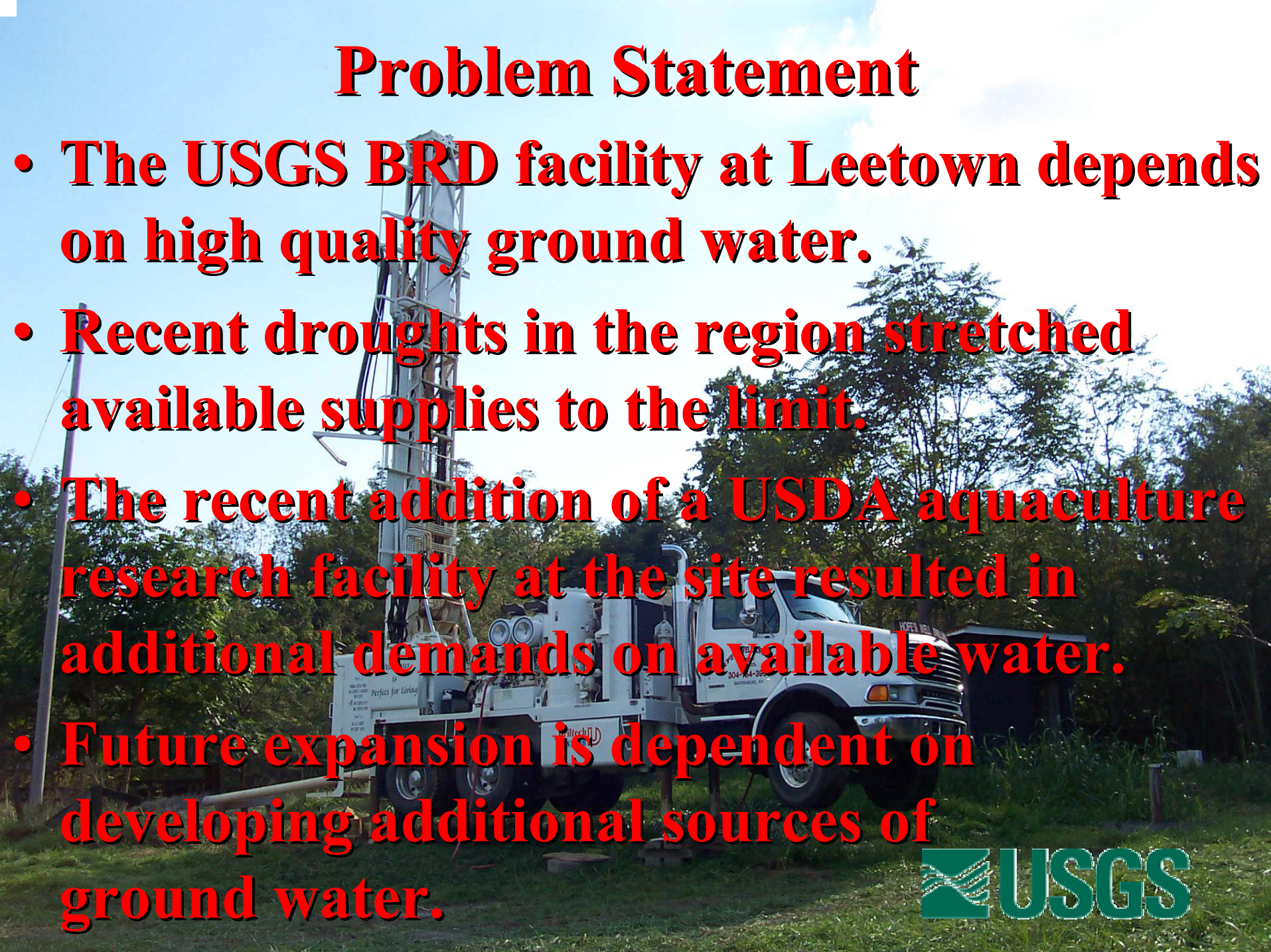
Current Status of the Leetown Hydrogeologic Assessment

- Funds needed to conduct the Leetown Hydrogeologic Assessment were allocated by Congress in February 2003.
- Preliminary work actually began at the site in November of 2002.
- Due to the nature of the project, the majority of field work for FY 03 was conducted by the geologic discipline.

USGS

Problem Statement

- The USGS BRD facility at Leetown depends on high quality ground water.
- Recent droughts in the region stretched available supplies to the limit.
- The recent addition of a USDA aquaculture research facility at the site resulted in additional demands on available water.
- Future expansion is dependent on developing additional sources of ground water.



Objectives of Leetown Hydrogeologic Assessment

- 1) Develop a detailed understanding of the hydrogeologic setting/properties of the Karst aquifer in the Leetown area, 2) Document the availability and quality of ground water in the area, 3) Evaluate patterns of land and water use that might impact ground water, 4) establish a monitoring network to determine ground-water availability/quality, and 5) Assess water availability as a function of drought/changes in land use.

USGS

Additional Objectives

- The hydrogeologic assessment proposed for the Leetown Science Center contains both applied and research elements.
- In addition to helping the Center manage available ground-water resources, a major objective is to test and evaluate methods at the Center which can then be applied to hydrogeologically similar areas within the Great Valley and throughout the nation.

Tasks Completed in FY 2003

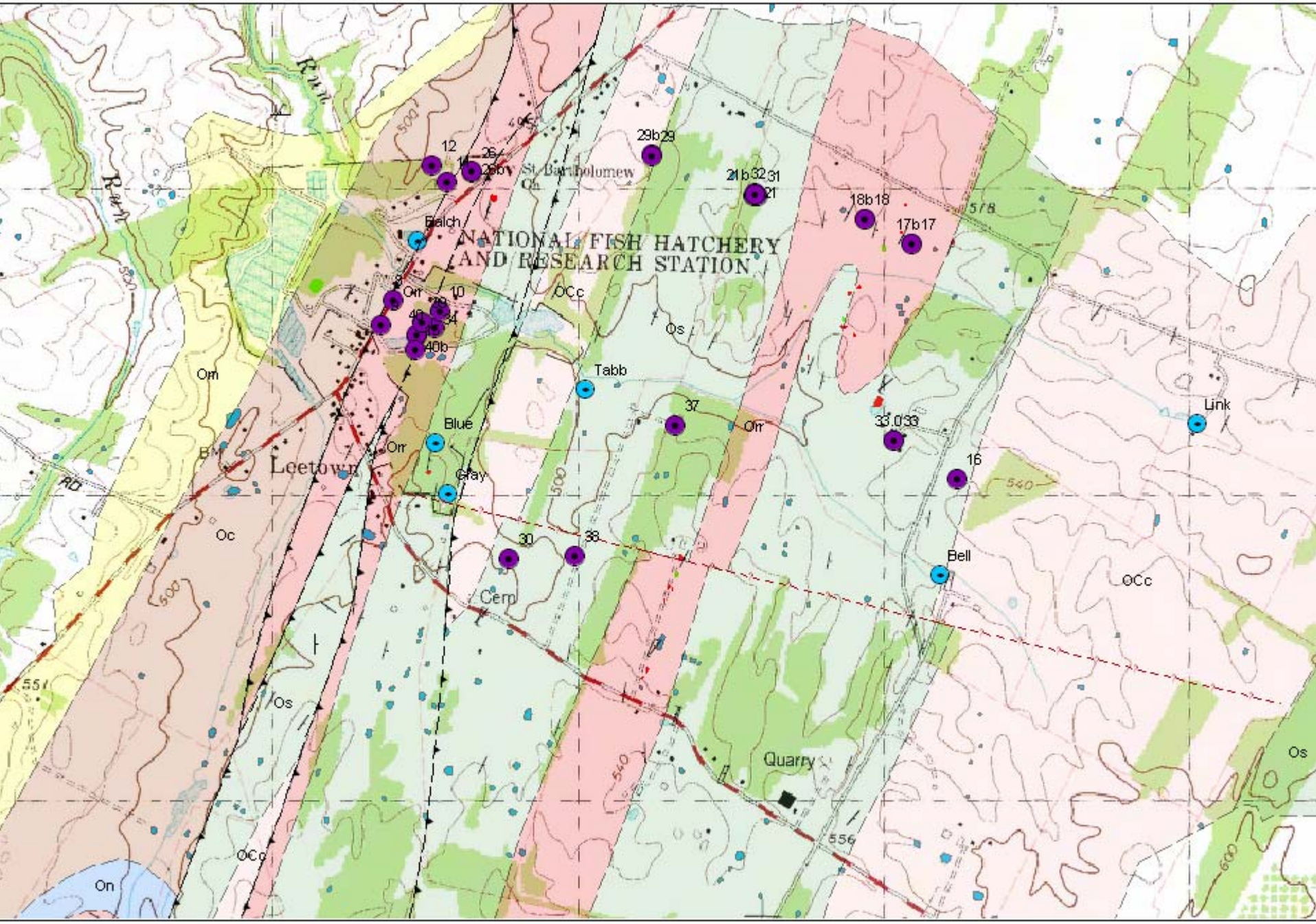
- Geologic, karst, and sinkhole mapping and geophysical surveys were conducted to help understand the fracture network.
- Nine bedrock wells and 8 shallow piezometers were drilled to document the type and degree of fracturing of the bedrock and to better understand the hydrogeologic setting over the entire site.
- A monthly monitoring well network was established for the Leetown area to assess temporal and spatial variation in water levels.

USGS

Tasks Completed in Fiscal Year 2003 - Continued

- Sensors to monitor levels at two springs, a stream gaging station, and two precipitation gages were installed at the facility.
- Preliminary borehole geophysical logging of the monitoring wells was conducted and employed several innovative methods.
- Preliminary analysis of the borehole geophysical data was conducted.

USGS


NATIONAL FISH HATCHERY
AND RESEARCH STATION
St. Bartholomew
Balch
Blue
Gray
Tabb
Link
Bell
Quarry
Leetown
Cem
Om
Os
OCc
Oc
On
12
29b29
21b32
31
21
18b18
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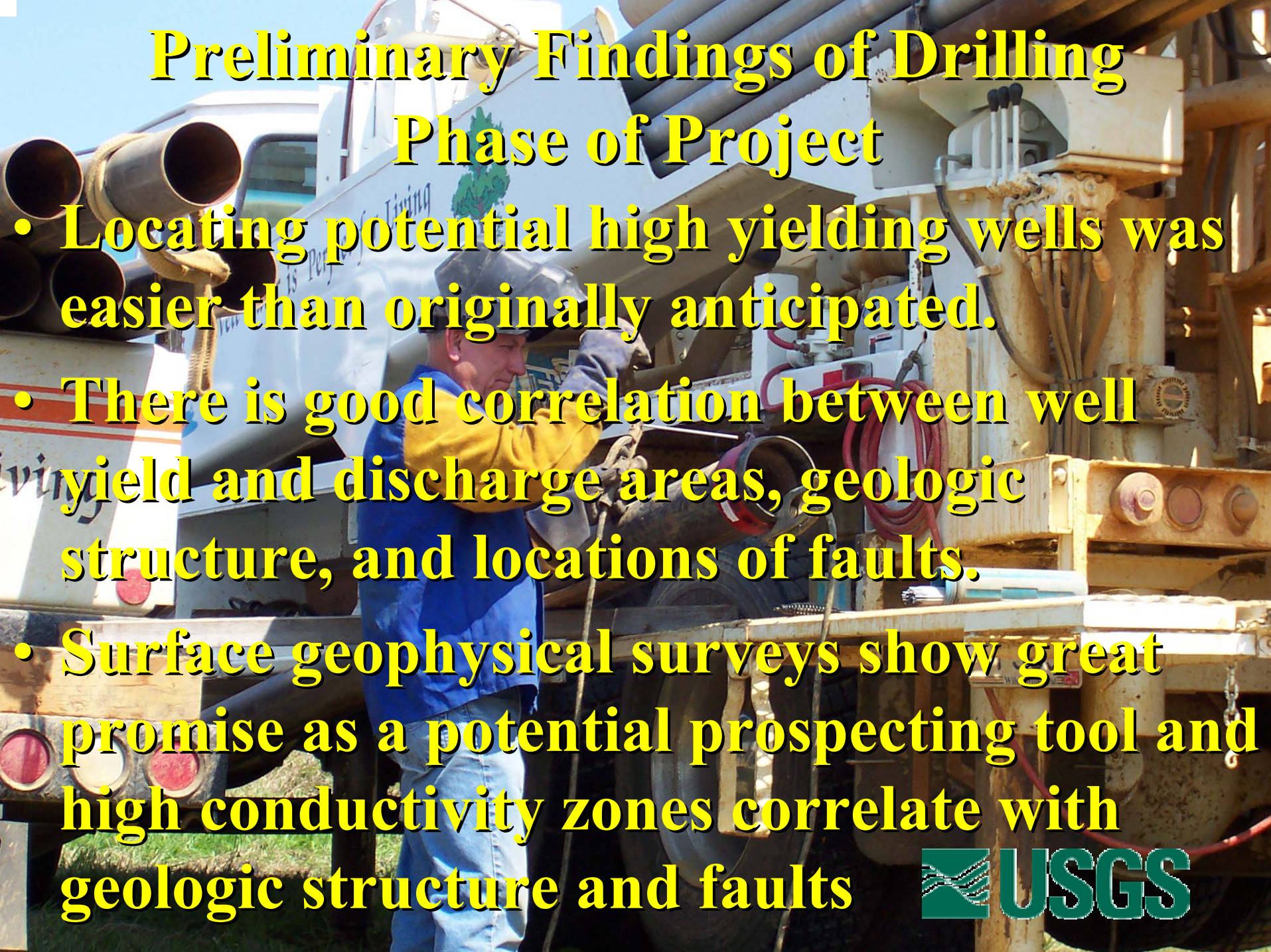
10
40b
37
33.033
16
30
38
500
540
556
578
600



Preliminary Findings of Drilling Phase of Project

- Locating potential high yielding wells was easier than originally anticipated.
- There is good correlation between well yield and discharge areas, geologic structure, and locations of faults.
- Surface geophysical surveys show great promise as a potential prospecting tool and high conductivity zones correlate with geologic structure and faults

USGS

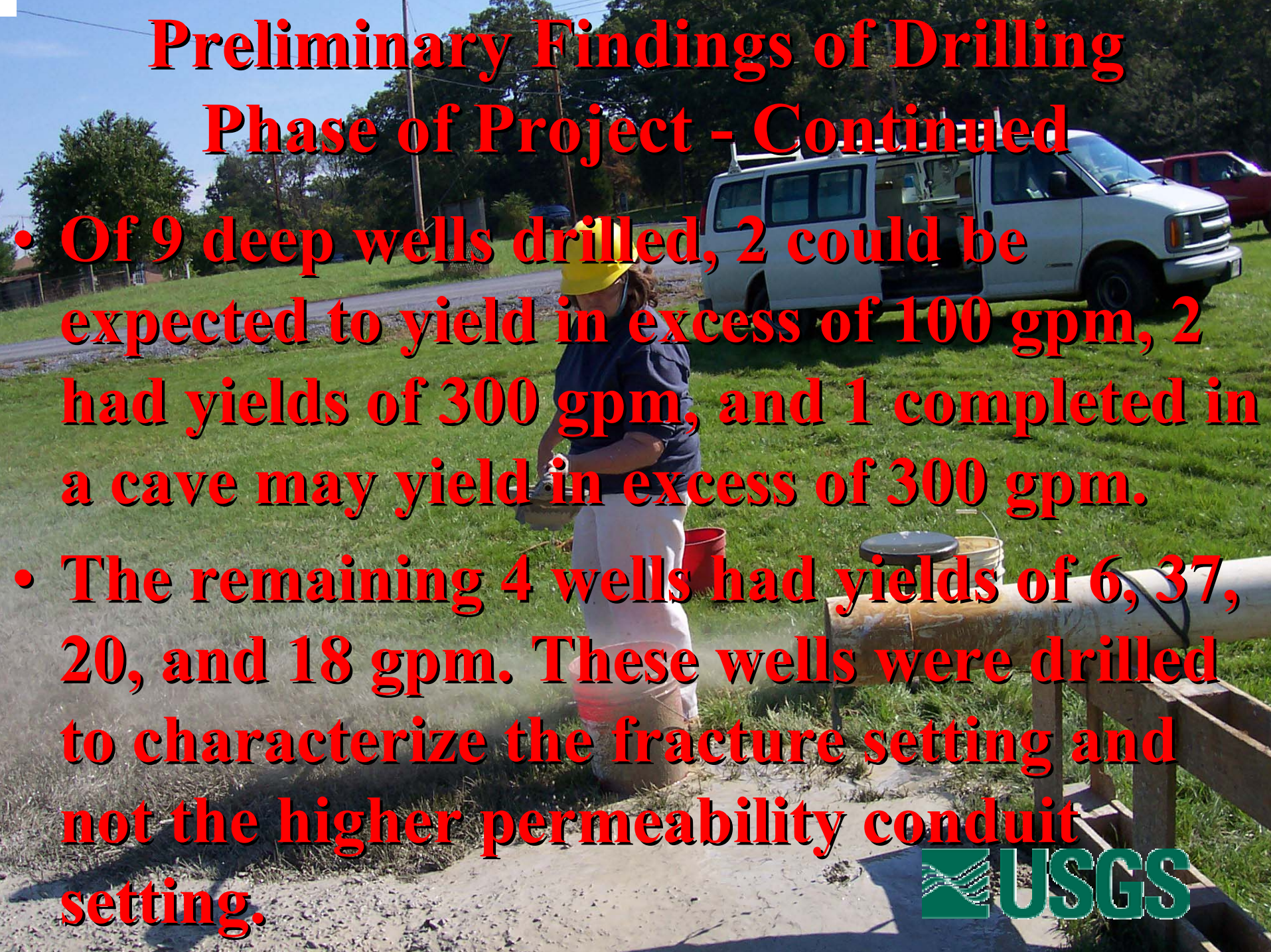
Preliminary Findings of Drilling Phase of Project - Continued

- Upper portion of aquifer is highly permeable, filled with solution voids, and has the capacity yield large quantities of water.
- This zone is characterized by large solution voids, many of which are clay filled.
- Water quality of these zones would likely be subject to contamination and may have problems with turbidity.

USGS

Preliminary Findings of Drilling Phase of Project - Continued

- Of 9 deep wells drilled, 2 could be expected to yield in excess of 100 gpm, 2 had yields of 300 gpm, and 1 completed in a cave may yield in excess of 300 gpm.
- The remaining 4 wells had yields of 6, 37, 20, and 18 gpm. These wells were drilled to characterize the fracture setting and not the higher permeability conduit setting.



Preliminary Findings of Drilling Phase of Project - Continued

- As was expected, both conduit and diffuse aquifer settings were identified.
- The large syncline in the upland area is intensely karstified and characterized by repeated solution voids to a depth of 160 feet and provides water to the wetland.
- The lowland area is also intensely karstified but is much more cavernous than the upland area. Water from this zone can be turbid.

USGS

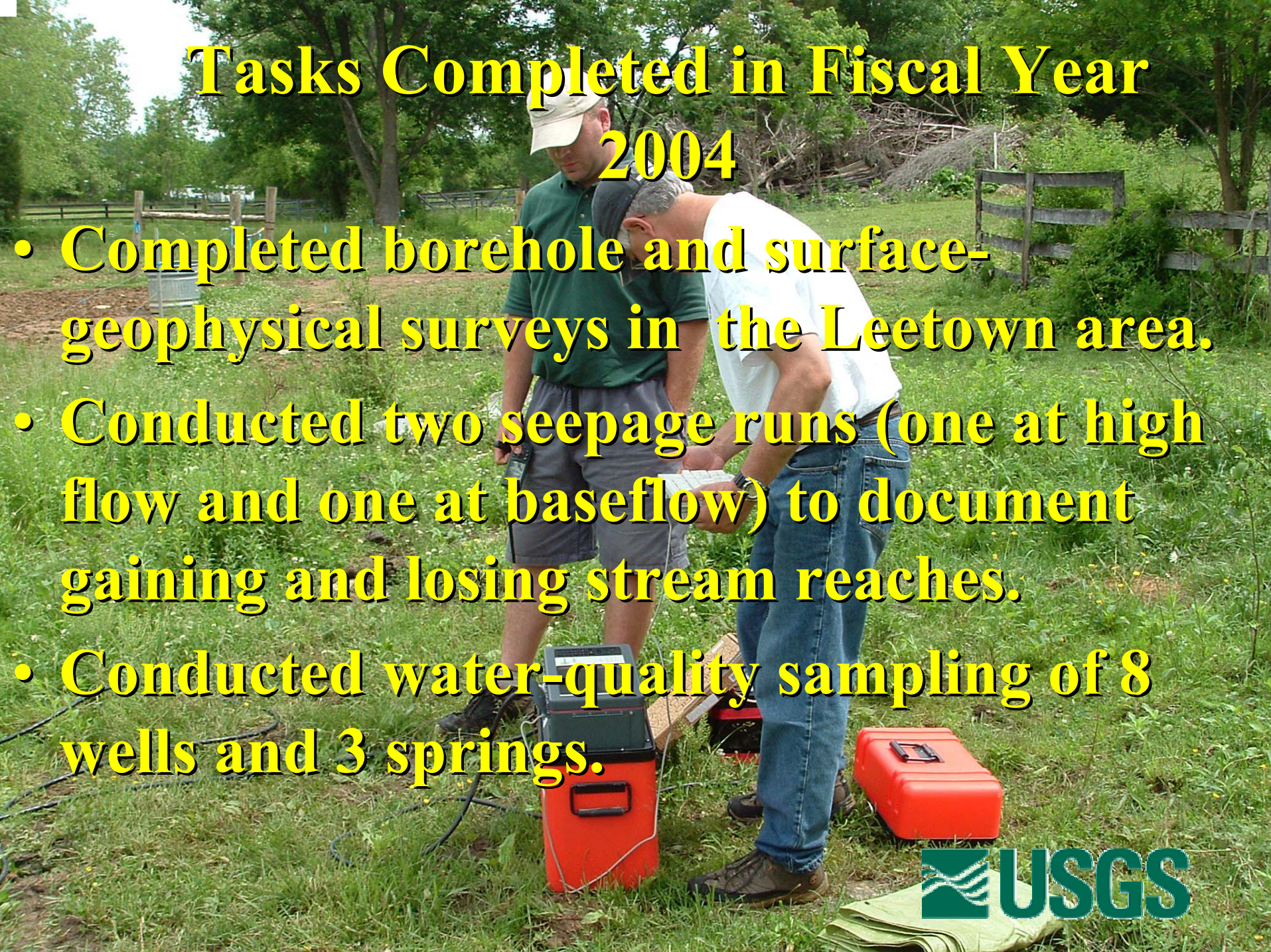
Preliminary Findings of Drilling Phase of Project - Continued

- A well drilled on a fault at the USDA yielded 300 gpm of water as anticipated but did not have the turbidity problems that were common to the wells in other areas. Unfortunately, bacterial contamination of the well is prevalent.
- A large 15 foot cavern was encountered when drilling the well at the softball field.
- Shallow piezometers drilled on the Tabb property had larger than average yields and may indicate a flow route to Gray Spring.

USGS

Tasks Completed in Fiscal Year 2004

- Completed borehole and surface-geophysical surveys in the Leetown area.
- Conducted two seepage runs (one at high flow and one at baseflow) to document gaining and losing stream reaches.
- Conducted water-quality sampling of 8 wells and 3 springs.

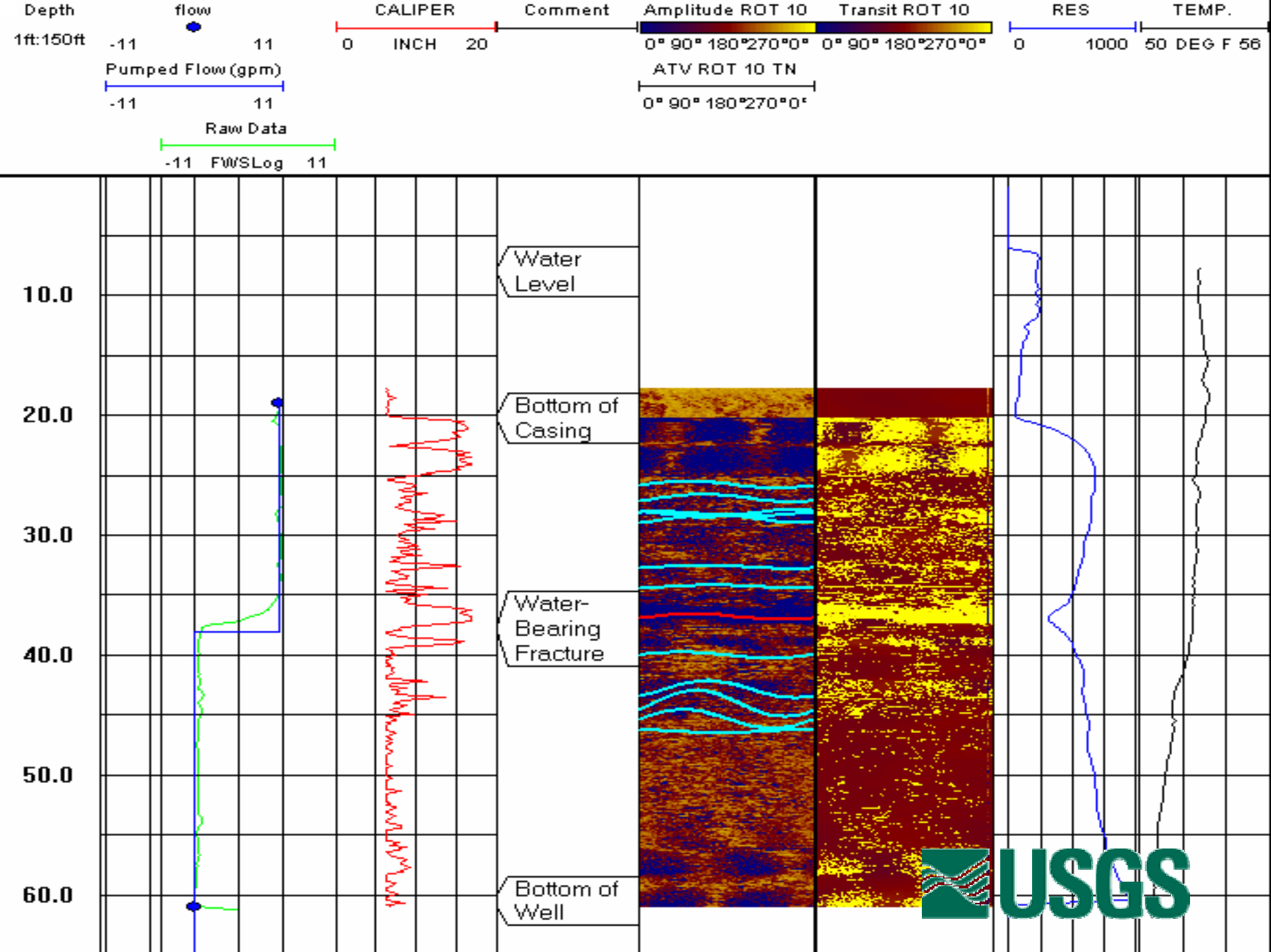


Tasks Completed in Fiscal Year 2004 - Continued

- Conducted short term/long term aquifer tests on 58 wells in the Leetown area to obtain hydraulic and water-level data.
- Continued monitoring water-levels in 22 monitoring wells on a monthly basis.
- Continued monitoring stream flow at Hopewell Run and water level at Gray and Balch Springs.

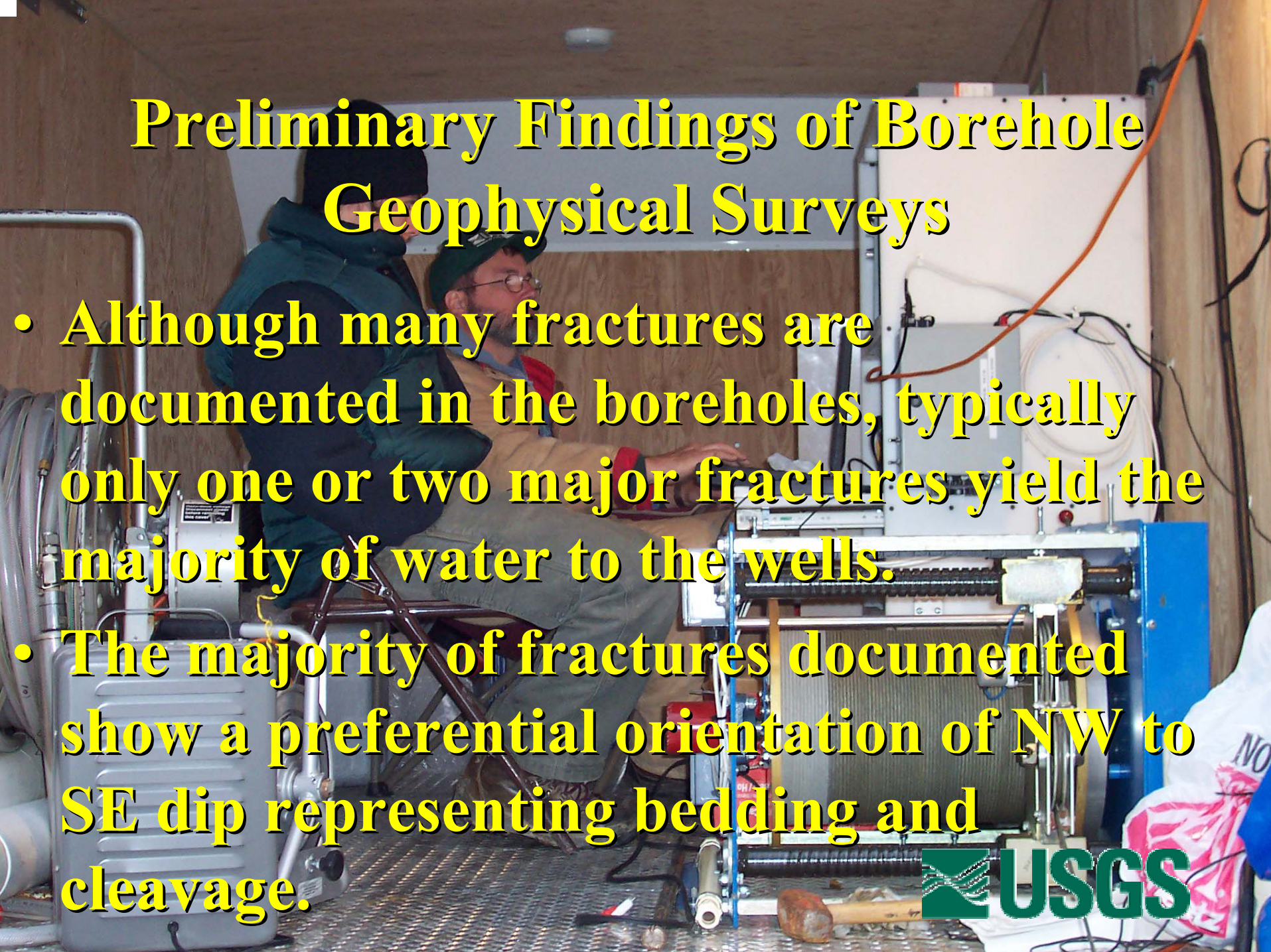
Tasks Completed in Fiscal Year 2004 - Continued

- Conducted 7 fluorometric tracer tests (2 stream and 5 ground water tests) in the Leetown area.
- Conducted discrete zone monitoring tests in 3 boreholes in the Leetown area.


Depth
1ft:150ft
flow
-11
11
Pumped Flow (gpm)
-11
11
Raw Data
-11 FWSLog 11
CALIPER
0 INCH 20
Comment
Amplitude ROT 10
0° 90° 180° 270° 0°
Transit ROT 10
0° 90° 180° 270° 0°
ATV ROT 10 TN
0° 90° 180° 270° 0°
RES
0 1000
TEMP.
50 DEG F 56
10.0
20.0
30.0
40.0
50.0
60.0
Water Level
Bottom of Casing
Water-Bearing Fracture
Bottom of Well
USGS

Preliminary Findings of Borehole Geophysical Surveys

- Although many fractures are documented in the boreholes, typically only one or two major fractures yield the majority of water to the wells.
- The majority of fractures documented show a preferential orientation of NW to SE dip representing bedding and cleavage.



Preliminary Findings of Borehole Geophysical Surveys - Continued

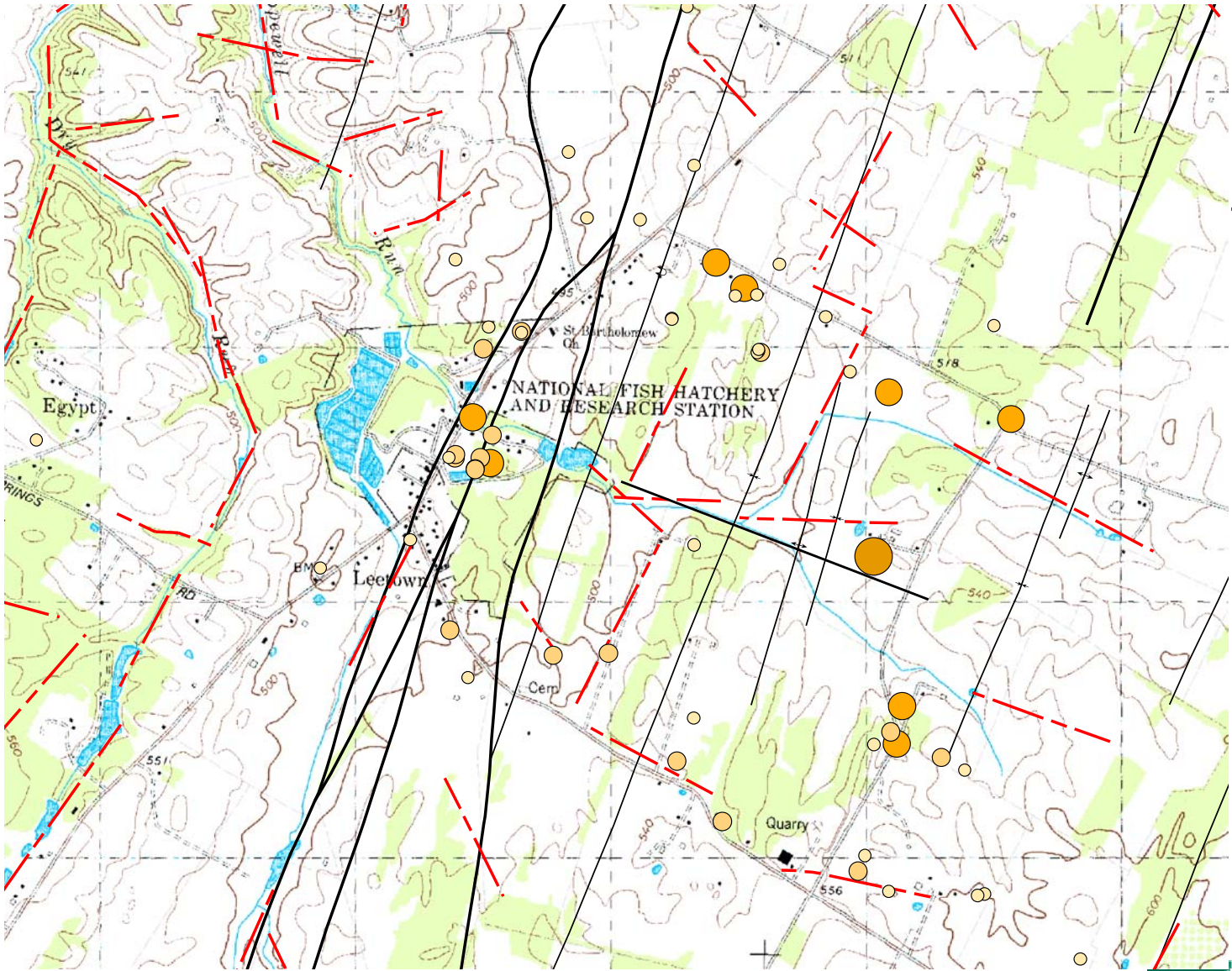
- Dip of fractures typically range from 10^{O} to 75^{O} with a high density near 35^{O} to 65^{O}, a few vertical fractures also occur but are not as common.
- Borehole deviation varies widely but NW to SE deviation is most common.
- The majority of water bearing fractures are in the upper part of the boreholes.

USGS

Preliminary Findings of Borehole Geophysical Surveys - Continued

Well Name	Total # of Significant Fractures	# of Water Yielding Fractures	Depth of Well (feet)	Depth of Water Bearing Fractures (feet below surface
USDA Sulfur	4	2	475	400, 472
Ball Field	7	2	160	70
Low Road	15	3	410	77, 93, 394
Stable C	9	2	321	62, 137
Stable B	7	2	326	234, 314
Stable A	9	2	312	60, 113, 220
Pest Monitor	3	1	61	37
Anticline	7	1	260	64
USDA Fault	10	1	201	158

USGS

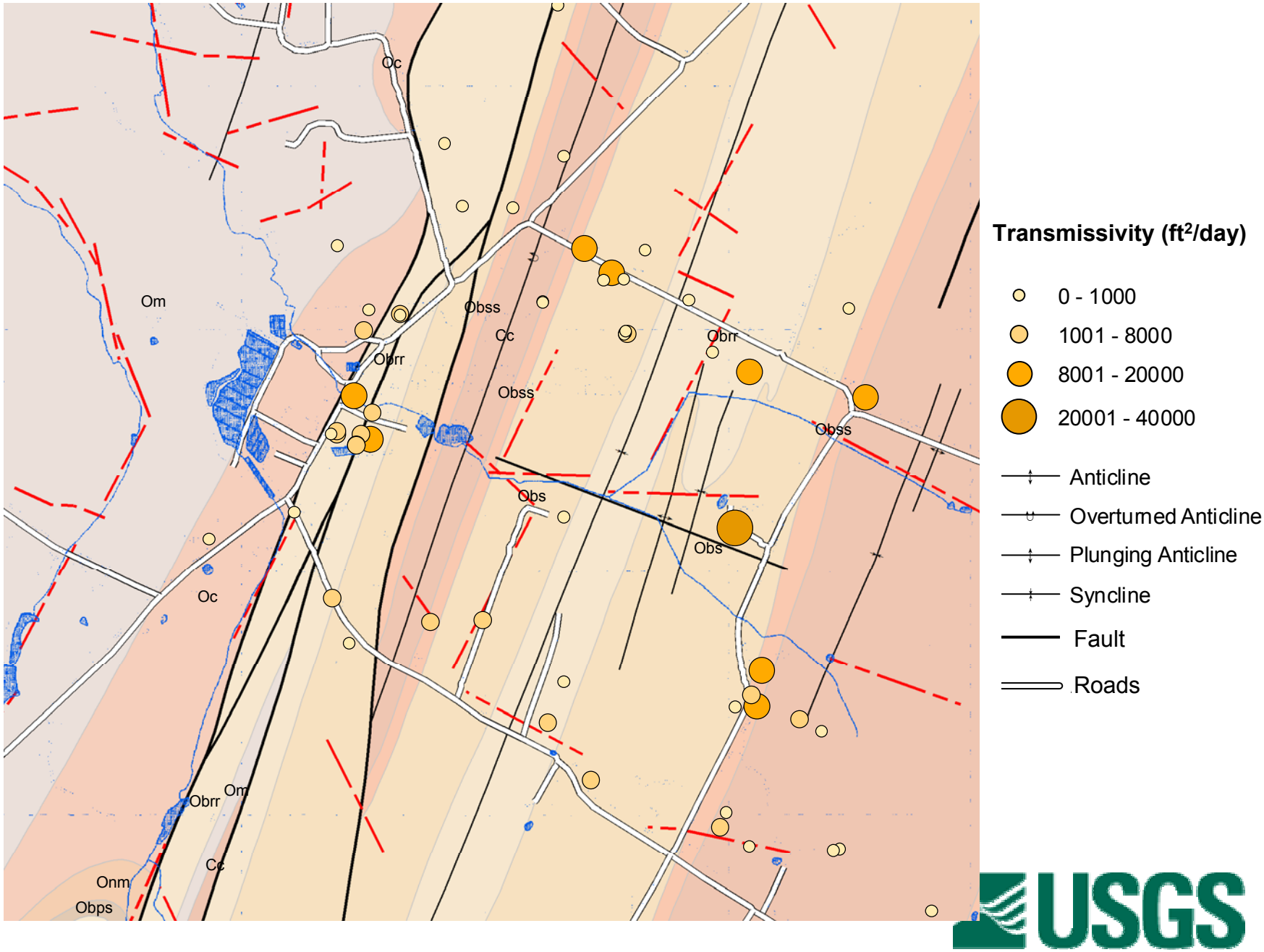

NATIONAL FISH HATCHERY
AND RESEARCH STATION
Egypt
Leetown
Quarry
Cem
Transmissivity (ft²/day)
0 - 1000
1001 - 8000
8001 - 20000
20001 - 40000
Anticline
Overturned Anticline
Plunging Anticline
Syncline
Fault

USGS

Preliminary Findings of Aquifer Tests- Continued

- Pump tests were conducted on 58 wells in the Leetown area.
- Transmissivity ranged from less than 1 to 40,000 ft^2/day, median transmissivity is approximately 1,000 ft^2/day.
- Of the 58 wells, the 11 having the highest transmissivity (>8,000 ft^2/day) all are located within the Beekmantown Group (median of 11,500 ft^2/day).

USGS


Oc
Om
Obss
Cc
Obrr
Obss
Obrr
Obss
Obs
Obs
Oc
Obrr
Om
Cc
Onm
Obps
Transmissivity (ft²/day)
0 - 1000
1001 - 8000
8001 - 20000
20001 - 40000
Anticline
Overturned Anticline
Plunging Anticline
Syncline
Fault
Roads

Preliminary Findings of Aquifer Tests

- Median transmissivity for wells tested in the Connococheague and Martinsburg formations is only 350 and 100 ft^2/day.
- Wells with higher transmissivity are typically (but not always) located along faults or axes of synclines/anticlines.
- The highest transmissivity well was located at the intersection of a syncline and a cross fault.

USGS

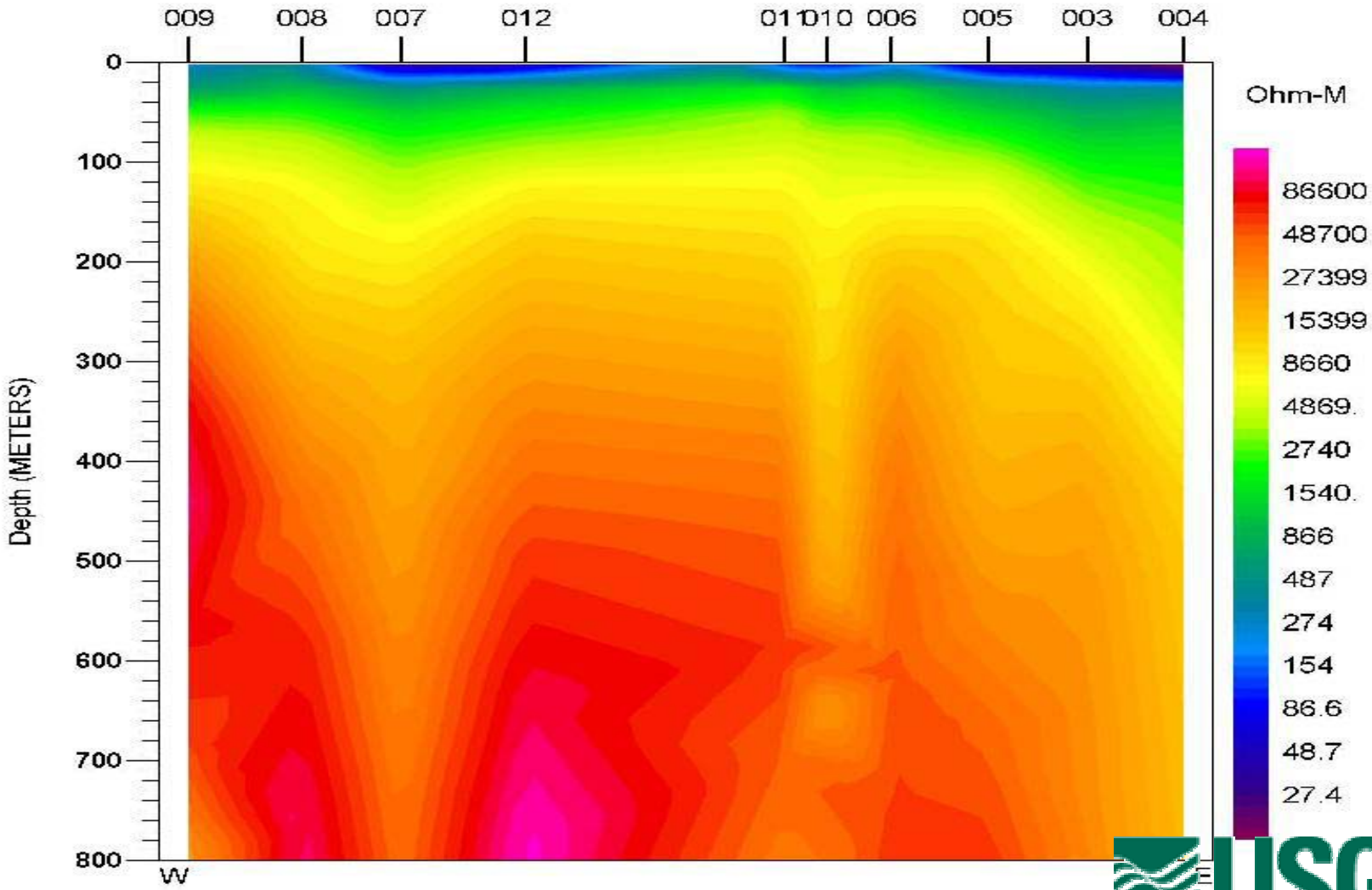
U. S. Geological Survey

12201 Sunrise Valley Drive
Reston, Virginia 20192

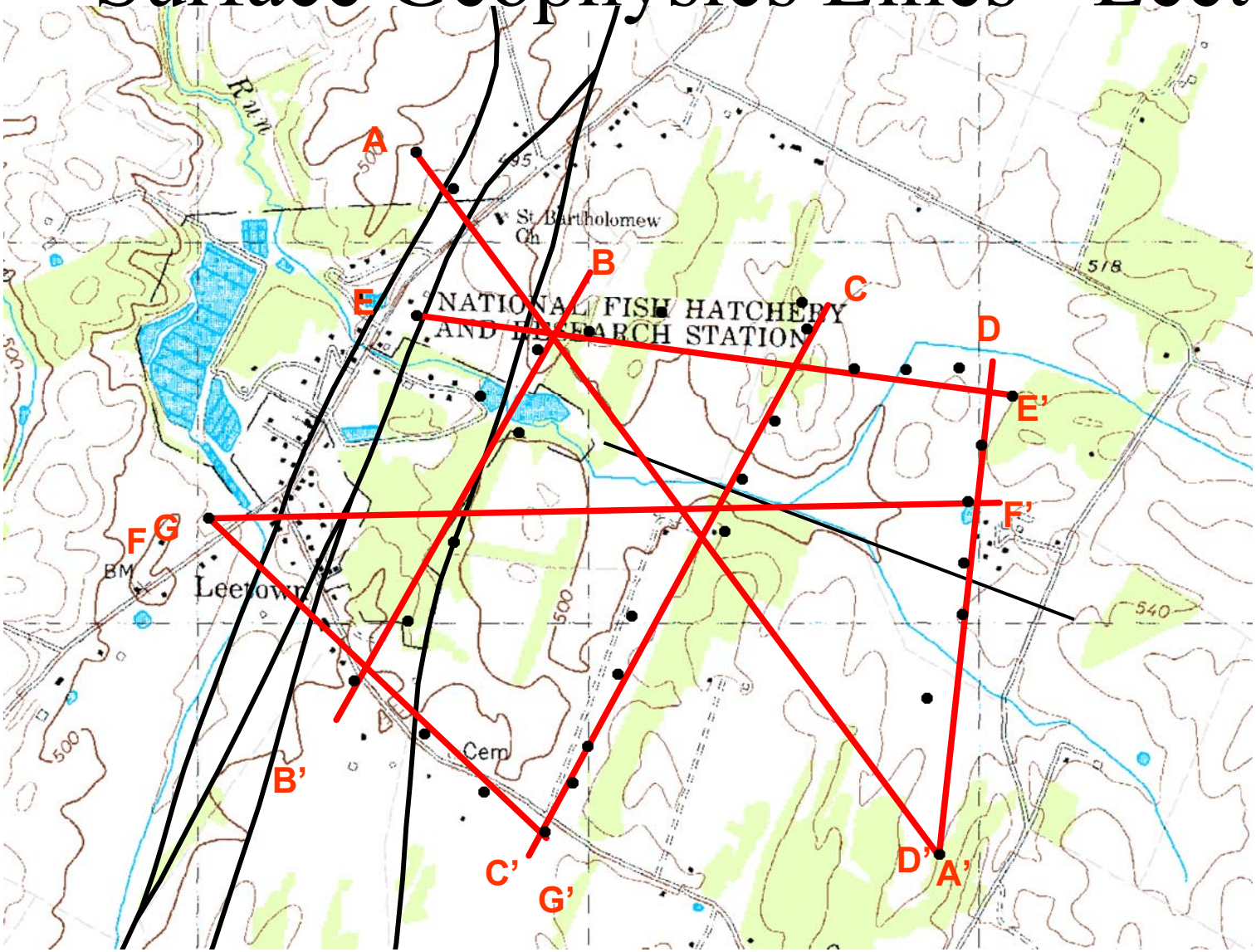
MT Data for: leetown

by

Herbert A. Pierce
12201 Sunrise Valley Drive
Reston, Virginia 20192 USA
(703) 648-6493



Surface Geophysics Lines - Leetown

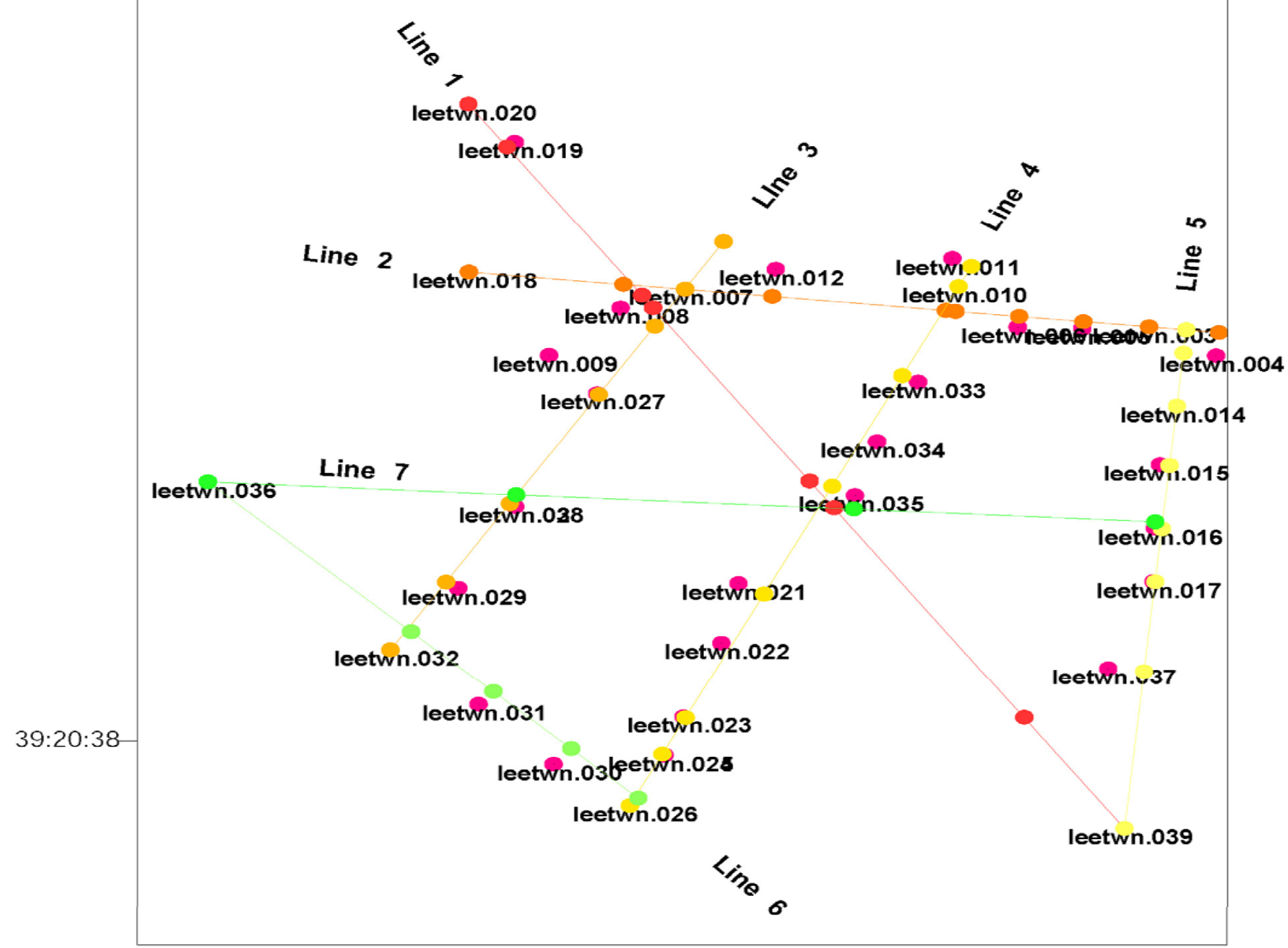


Data Point

Geophysics Line

Fault

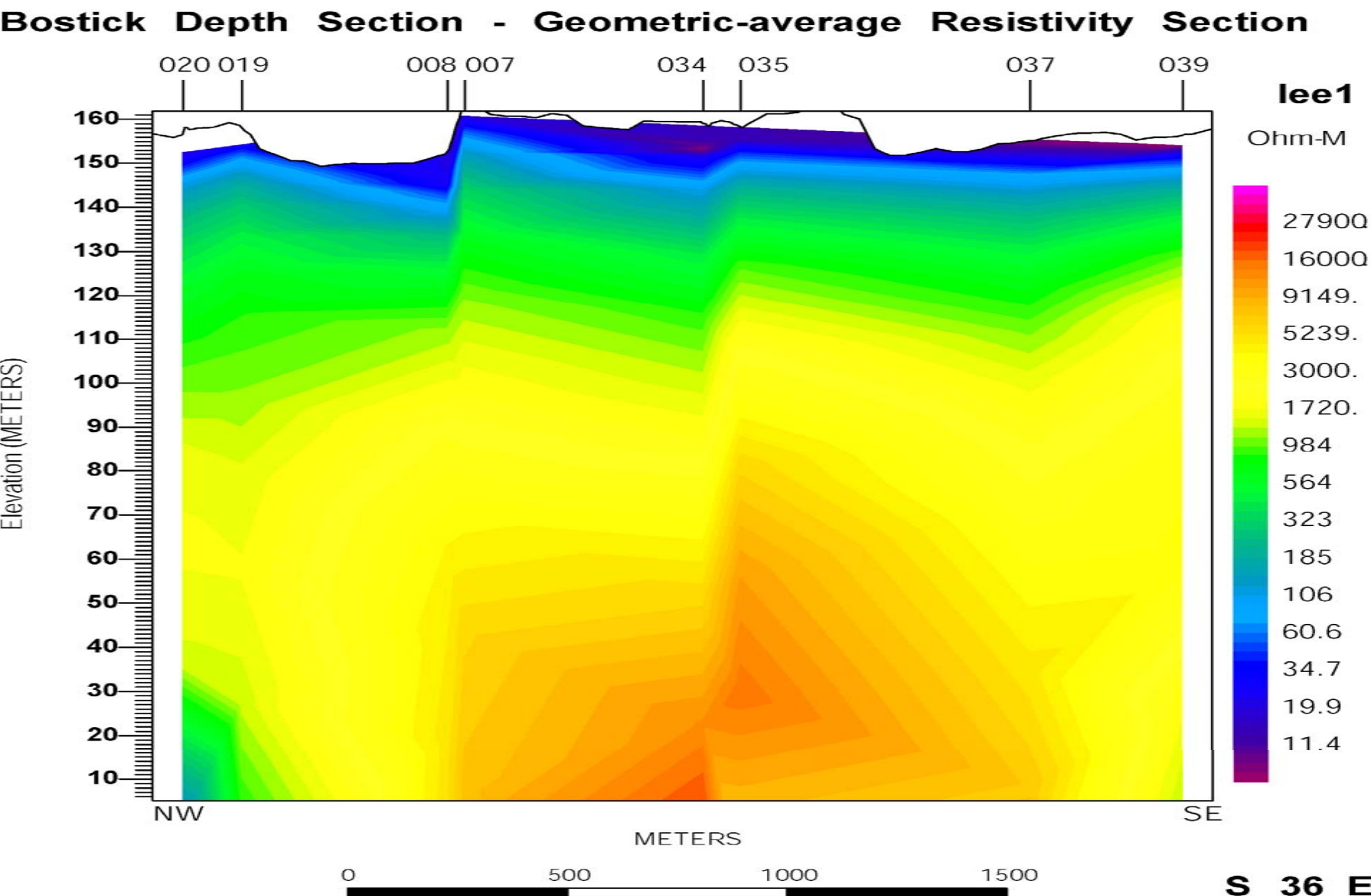
USGS



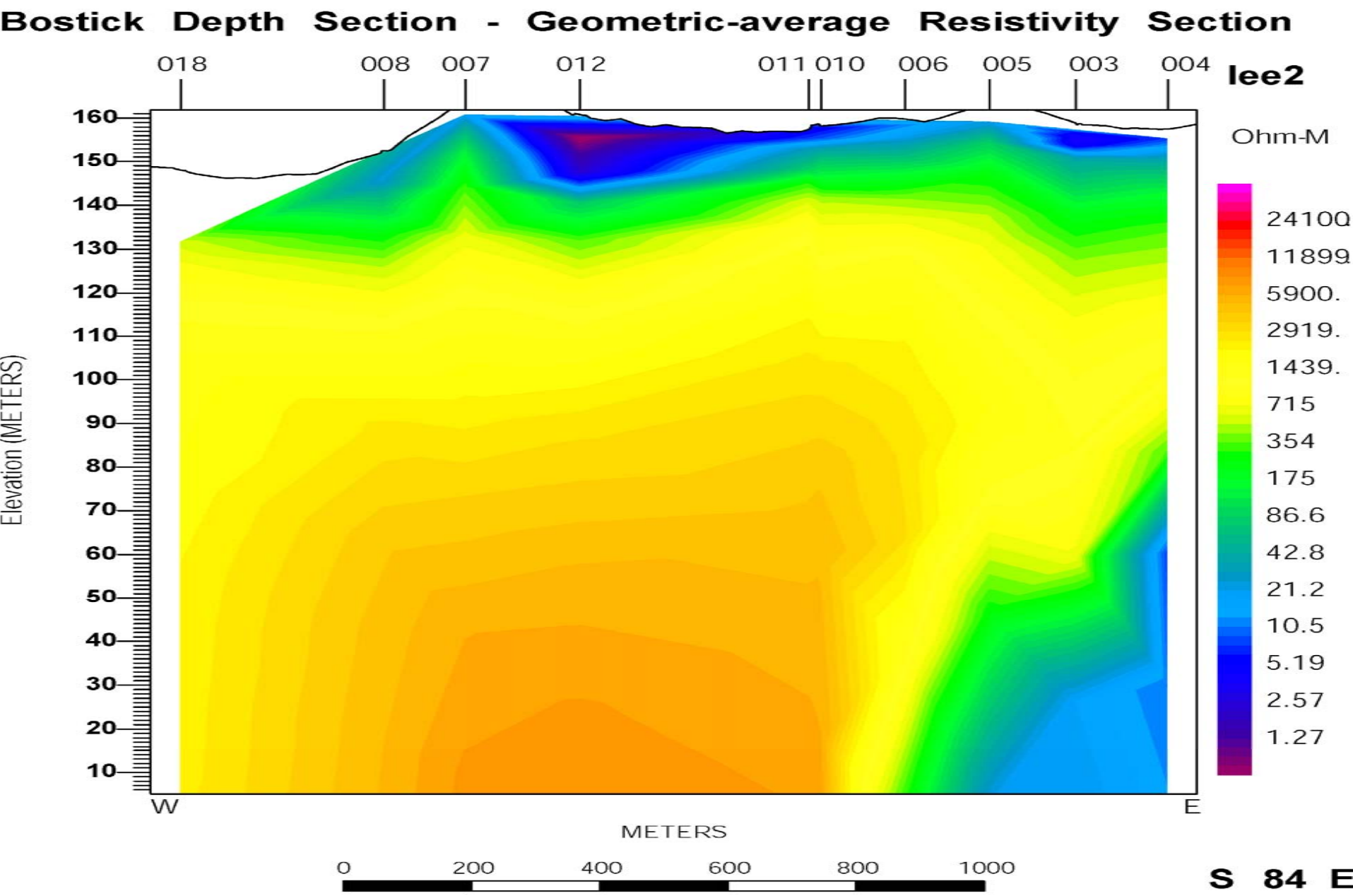
Leetown

Date: 11/15/04
Projection: UTM 18
C Merid: -75
Northing: 0.0
Easting: 500000

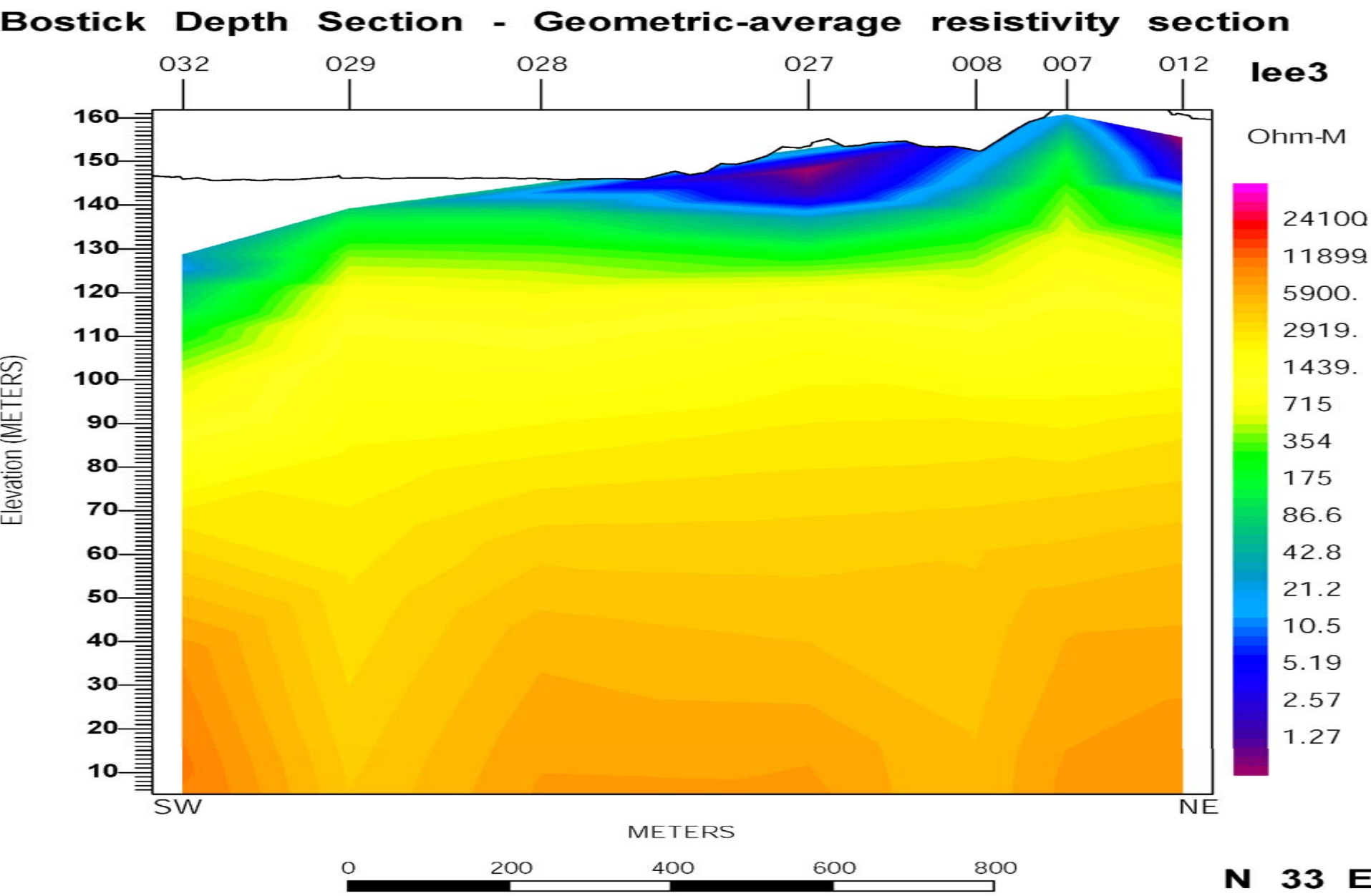
Leetown line 1 (A-A’)



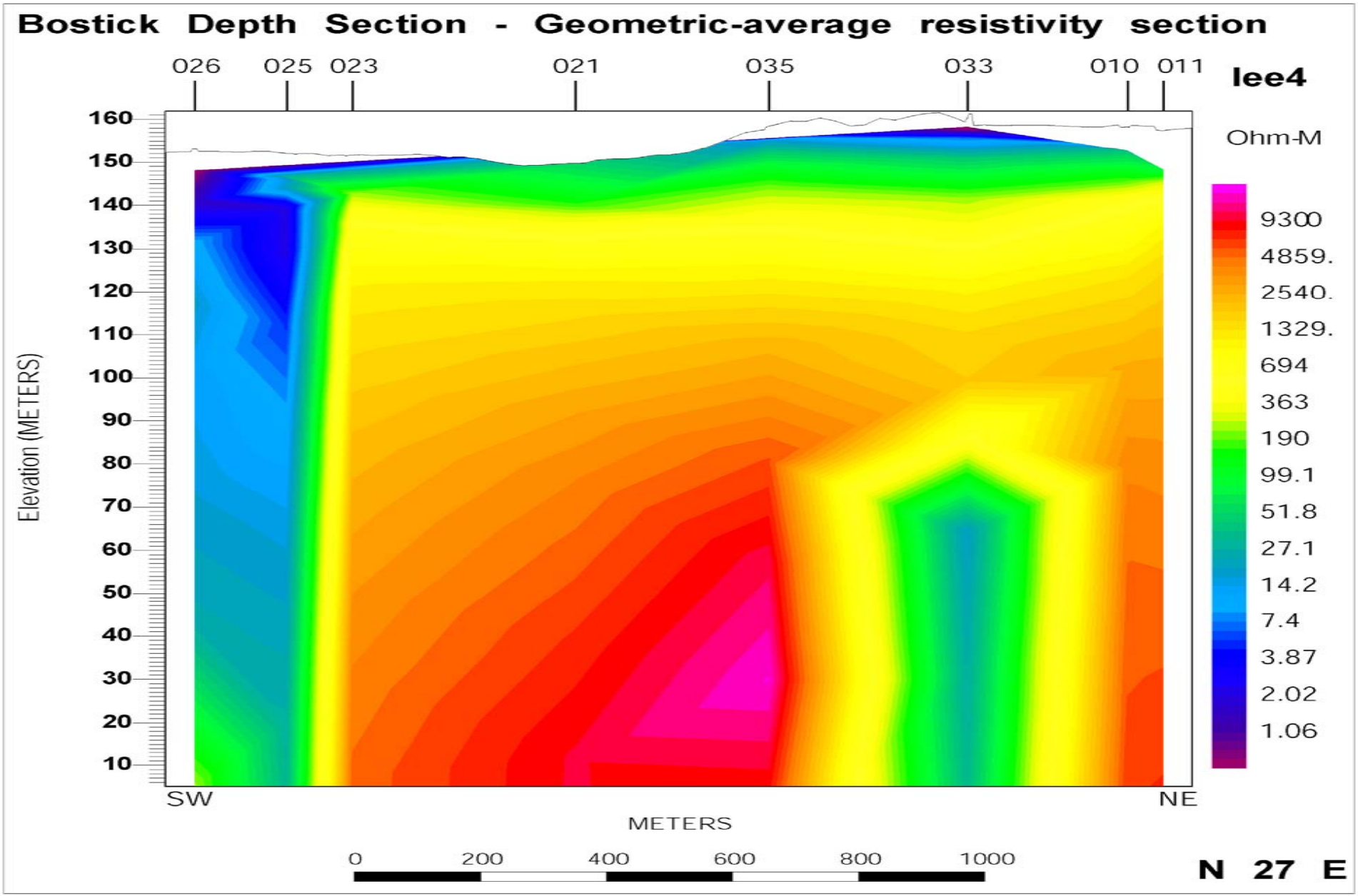
Leetown line 2 (E-E’)



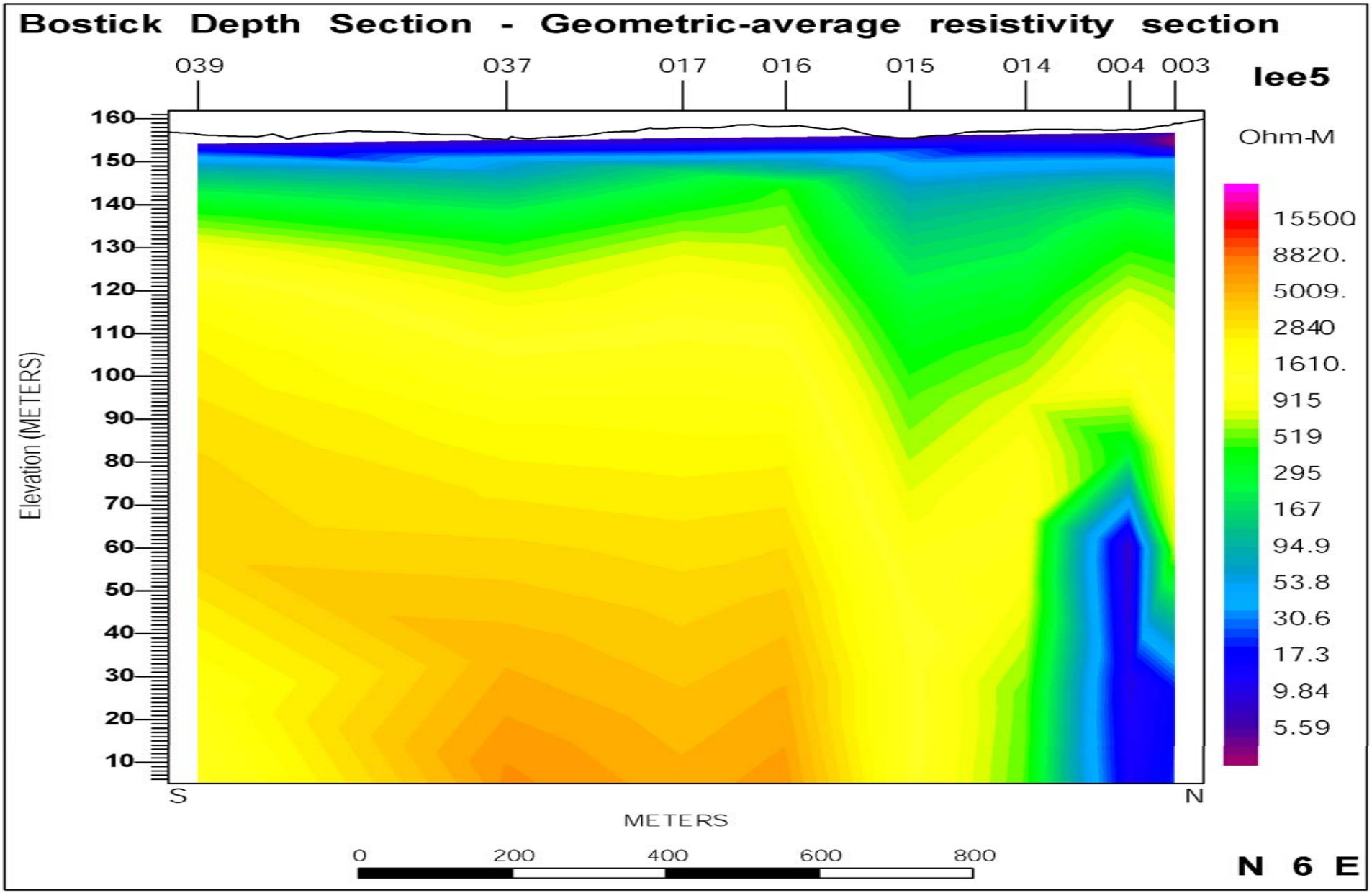
Leetown line 3 (B-B’)



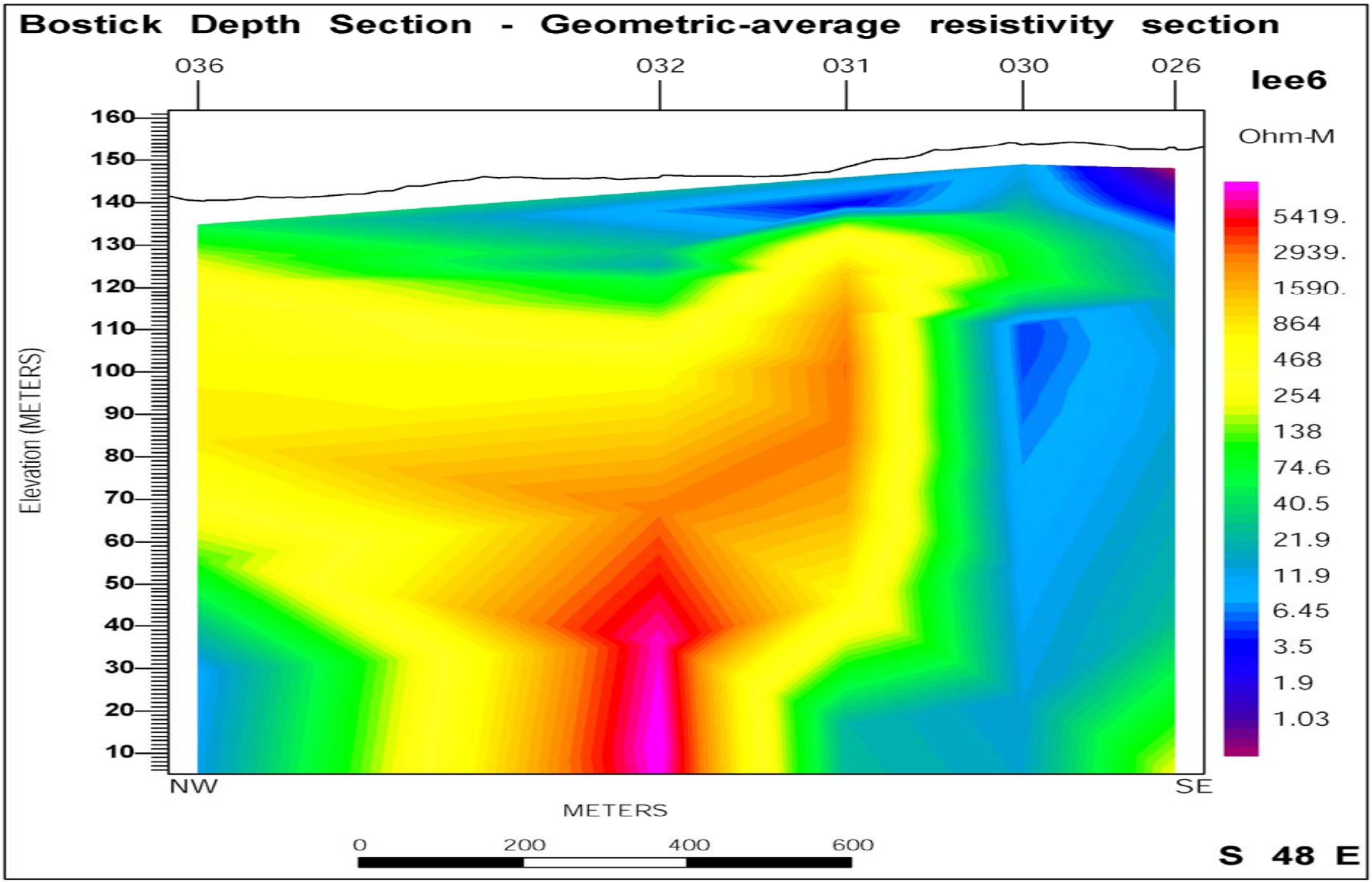
Leetown line 4 (C-C’)



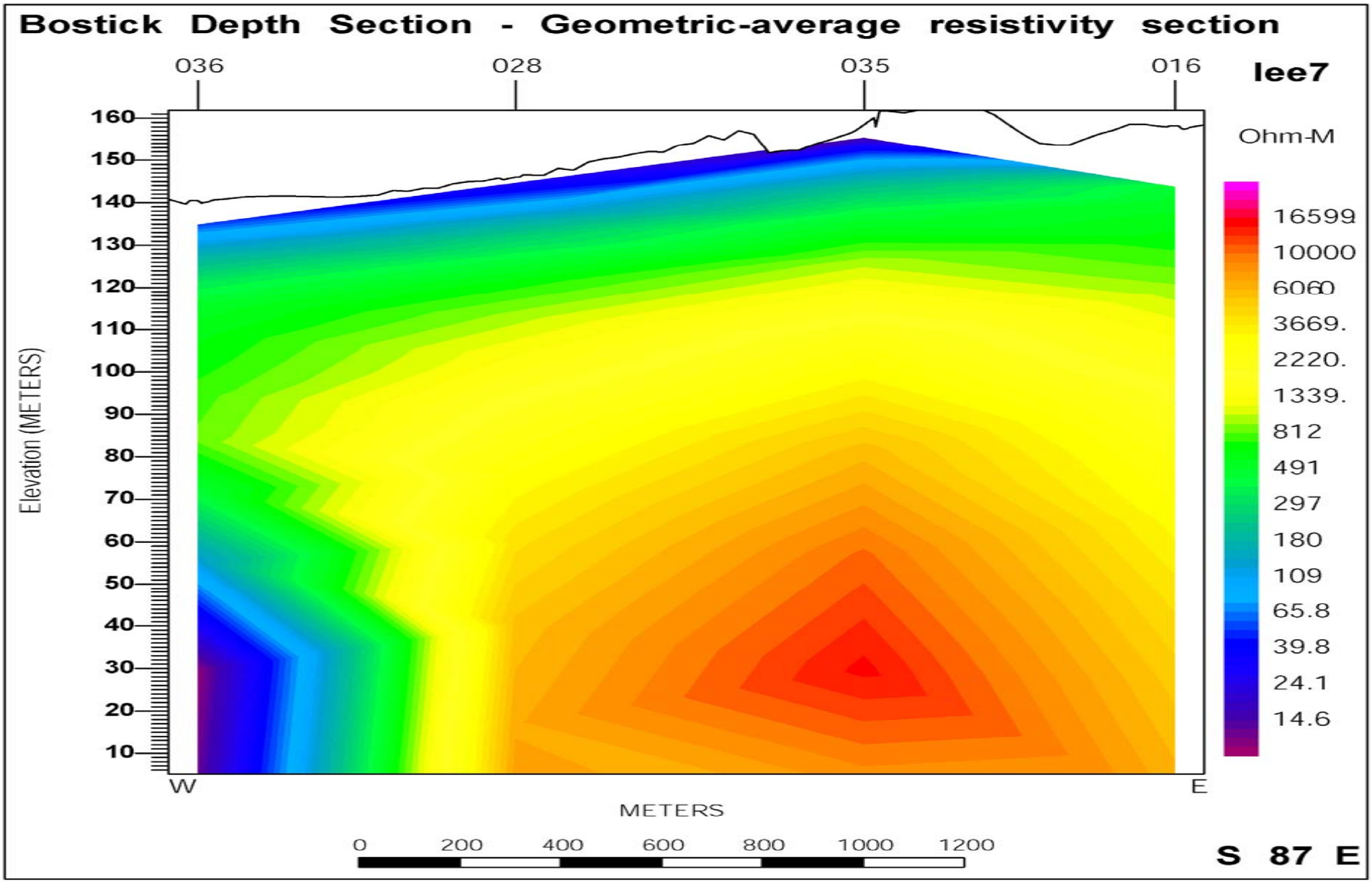
Leetown Line 5 (D-D')

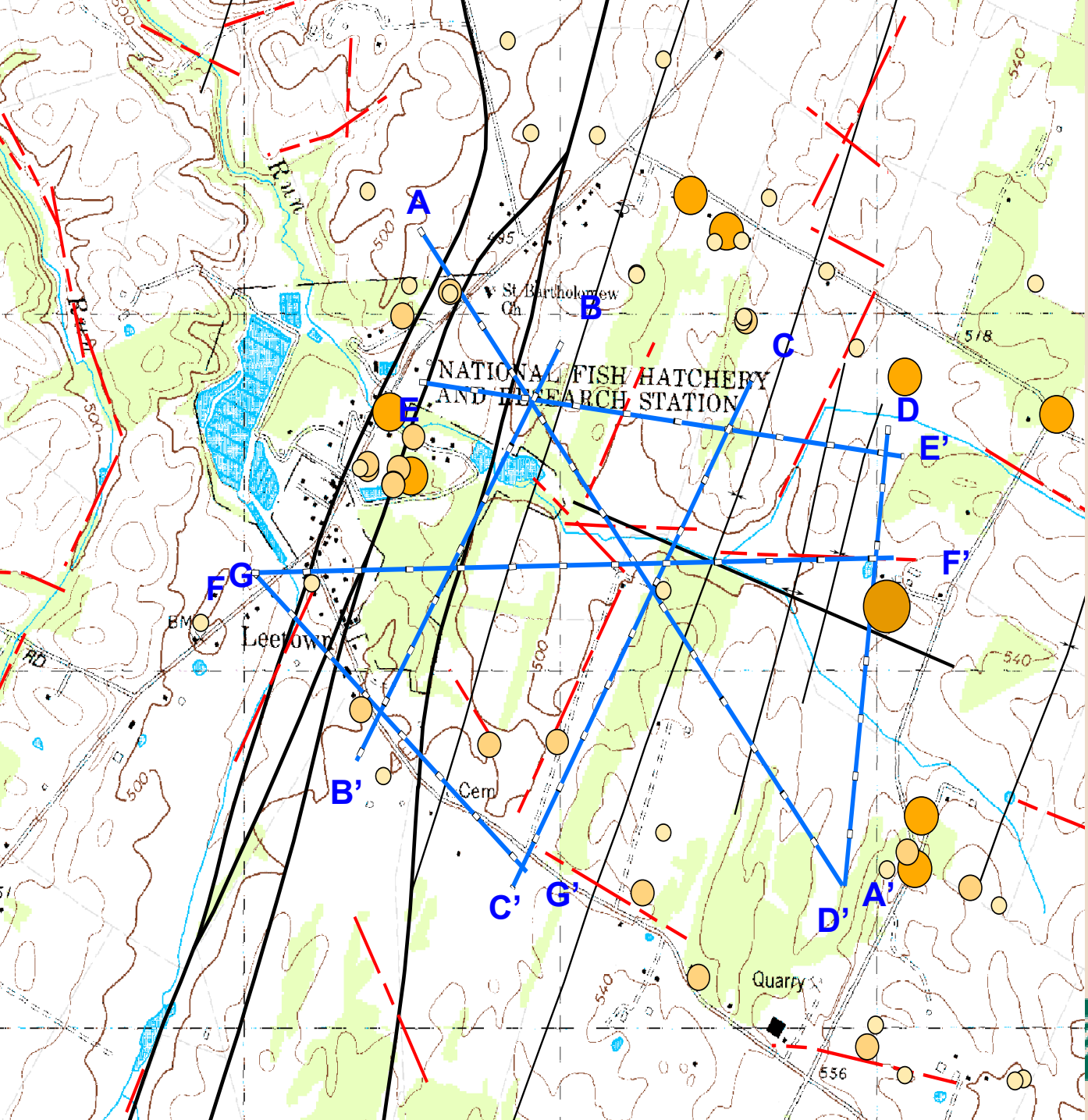


Leetown Line 6 (G-G')



Leetown Line 7 (lee7)





Transmissivity (ft^2/day)

- 0 - 1000
- 1001 - 8000
- 8001 - 20000
- 20001 - 40000

- Anticline
- Overturned Anticline
- Plunging Anticline
- Syncline
- Fault
- Geophysics Line

USGS

Preliminary Findings of Water-Quality Sampling

- 11 sites were sampled for a wide array of water-quality constituents including VOCs common ions, trace metals, pesticides, bacteria, dissolved gases, nutrients, and ground-water age dating constituents.
- Most data has not been fully analyzed at the USGS National Water Quality Laboratory.

USGS

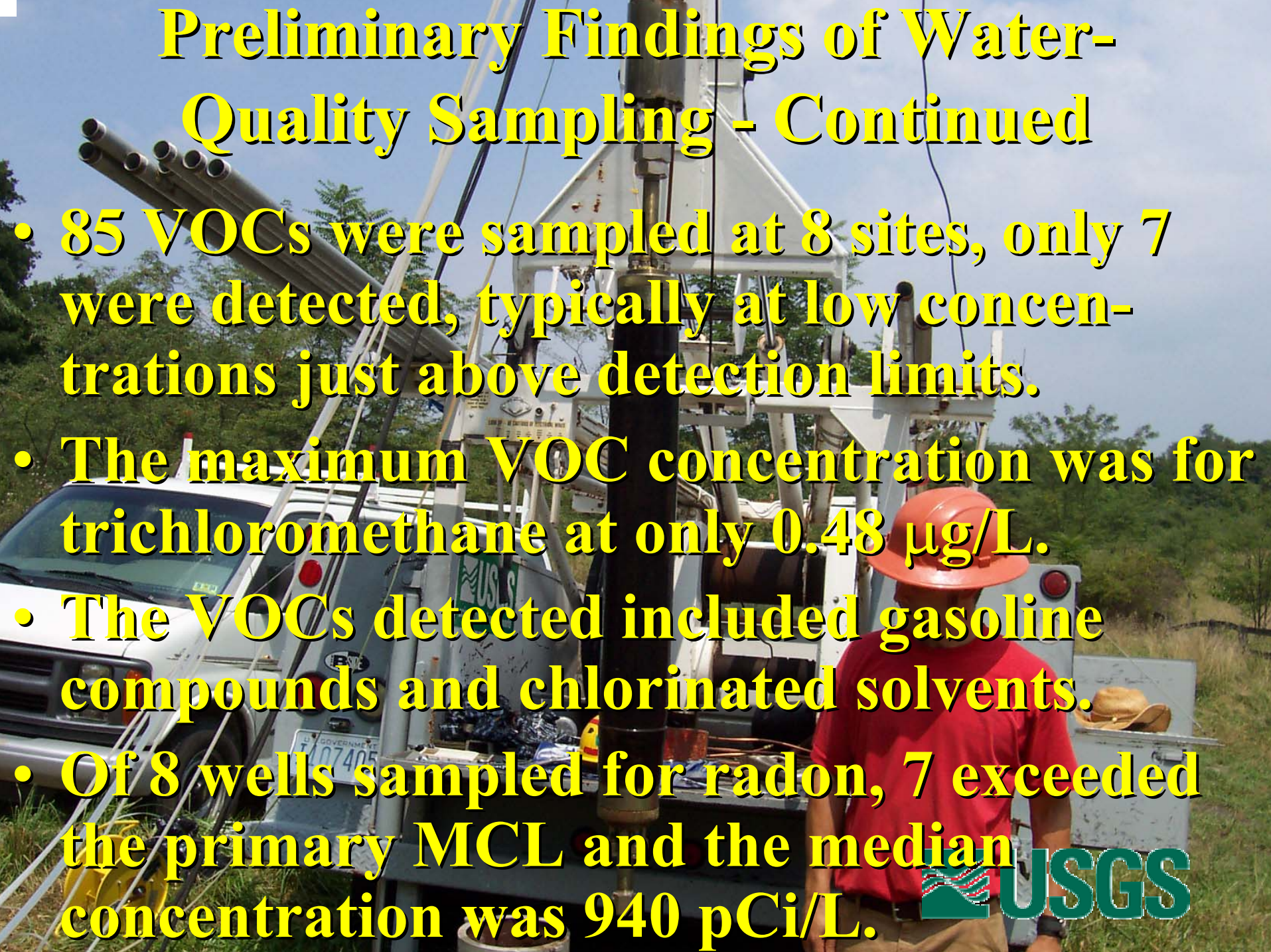
Preliminary Findings of Water-Quality Sampling - Continued

- 10 of 11 sites (8 wells and 3 springs) tested positive for Total Coliform bacteria at concentrations ranging from 68 – 700 colonies/100 ml of sample (median of 143).
- 5 of the 11 sites also tested positive for fecal coliform and E. Coli bacteria although at low concentrations (median concentration of only 3 colonies/100 ml of sample).

USGS

Preliminary Findings of Water-Quality Sampling - Continued

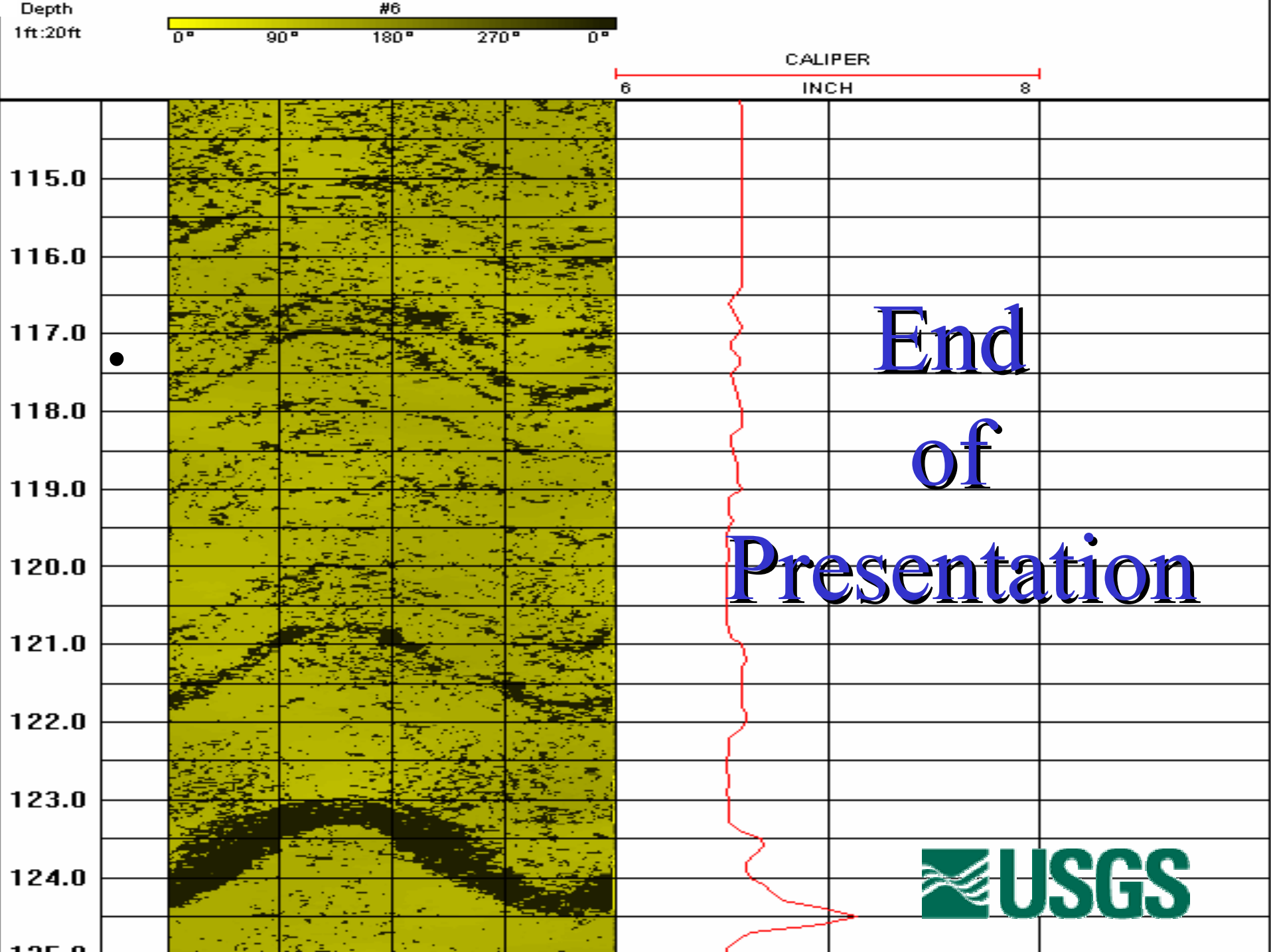
- 85 VOCs were sampled at 8 sites, only 7 were detected, typically at low concentrations just above detection limits.
- The maximum VOC concentration was for trichloromethane at only 0.48 µg/L.
- The VOCs detected included gasoline compounds and chlorinated solvents.
- Of 8 wells sampled for radon, 7 exceeded the primary MCL and the median concentration was 940 pCi/L.



Tasks Scheduled for FY 2005

- Complete analysis of borehole and surface geophysics data.
- Complete analysis of water-quality data
- Begin preparation of ground-water flow model.
- Complete analysis of seepage run data
- Complete analysis of miscellaneous data sets (eg. pump tests, dye tracer tests etc.).

USGS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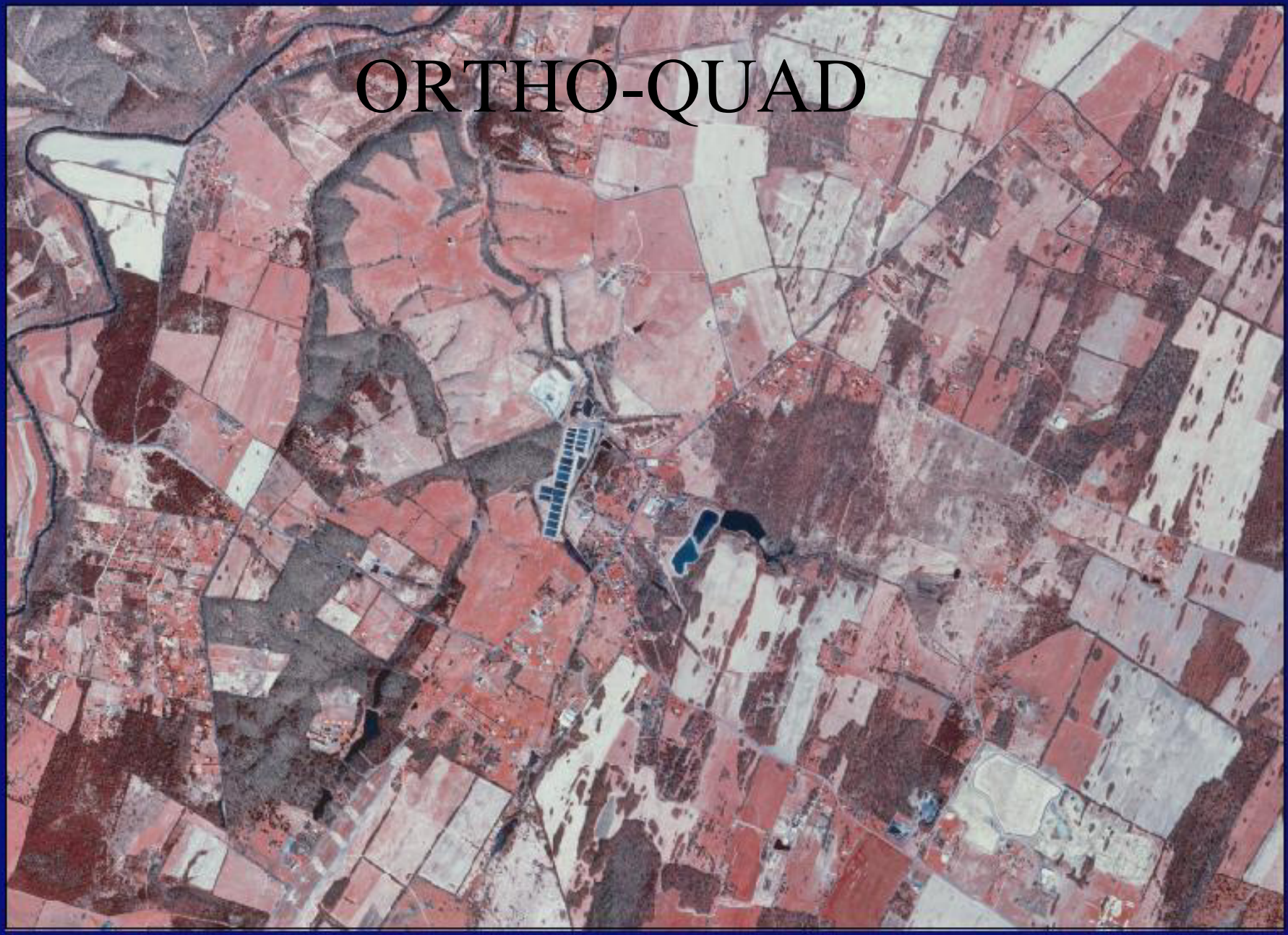
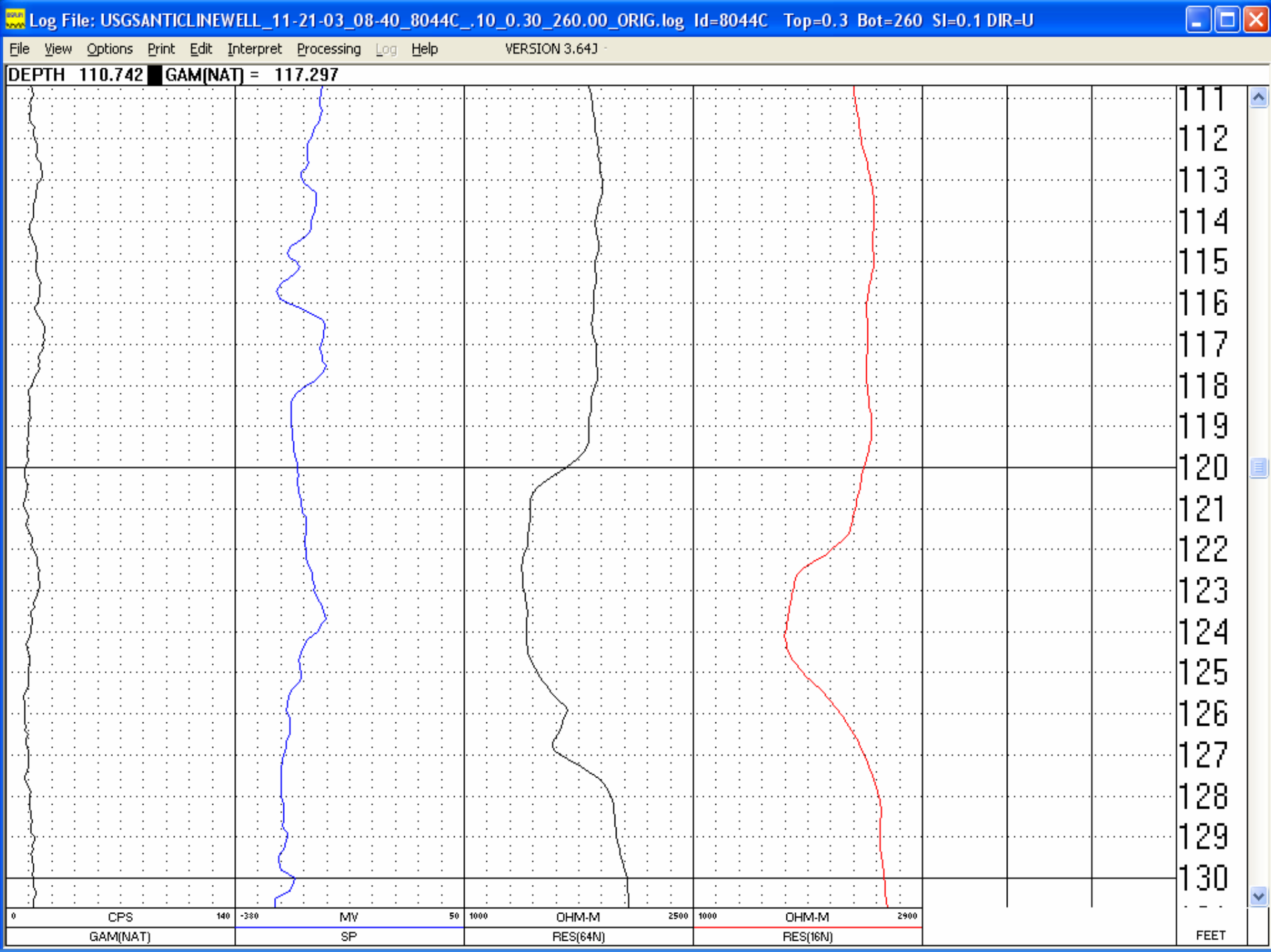
0°
90°
180°
270°
0°
CALIPER
6
INCH
8
115.0
116.0
117.0
118.0
119.0
120.0
121.0
122.0
123.0
124.0
End
of
Presentation
USGS

ORTHO-QUAD



1:24,000

Leetown Science Center and surrounding community- from 1:12,000 scale orthophoto quarter-quads, 1997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VERSION 3.64J
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111
112
113
114
115
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122
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125
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127
128
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GAM(NAT)
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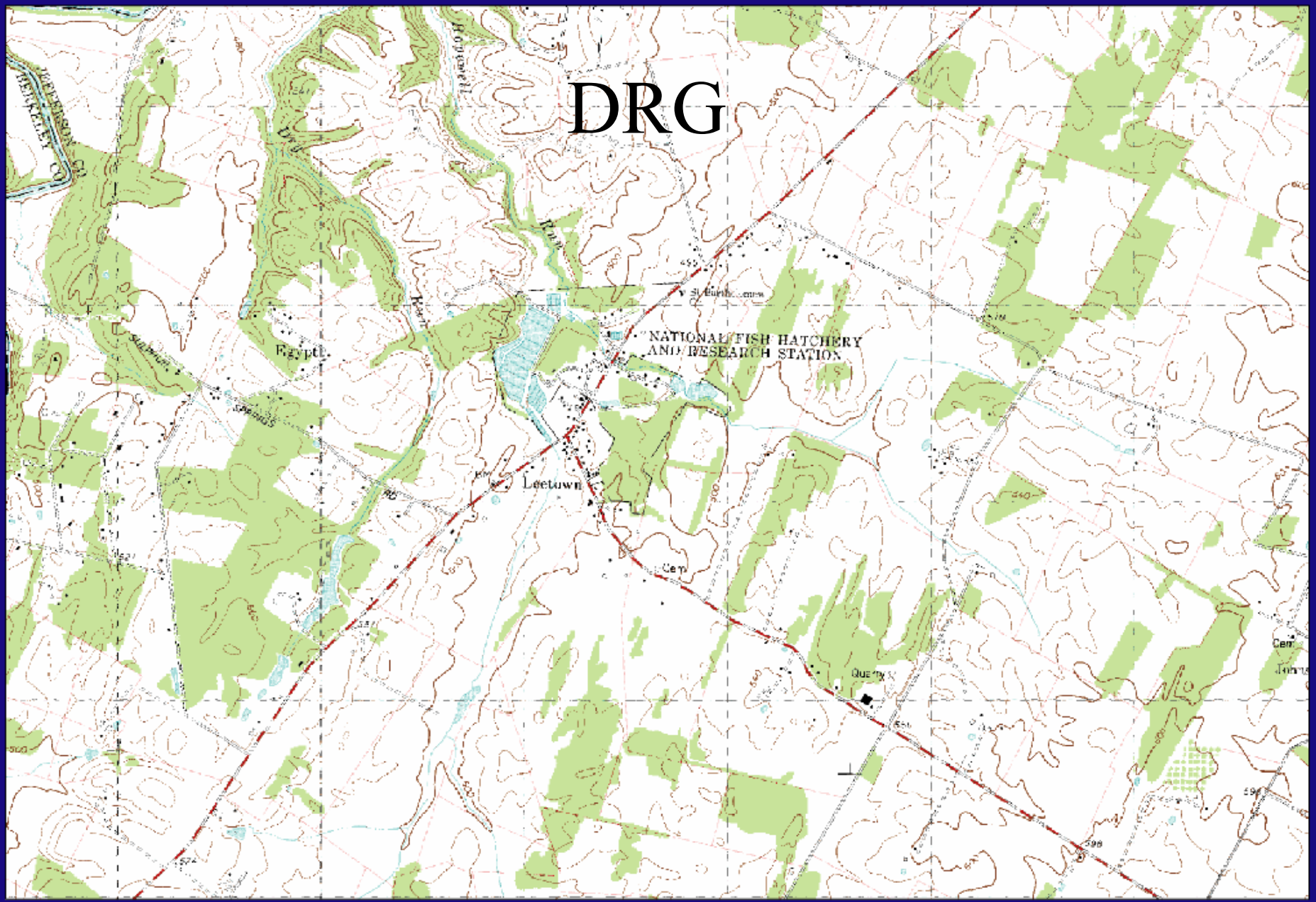
SP
1000 OHM-M 2500
RES(64N)
1000 OHM-M 2900
RES(16N)
FEET



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Leetown Science Center- quadrangle from 1978

Approach to Achieving Project Objectives

- FY 2003 – conduct Karst/geologic mapping, surface geophysical surveys, and install monitoring wells. FY 2004 – prepare geologic/Karst maps, conduct borehole geophysical surveys, analyze geophysical data, conduct short term/long term aquifer tests, conduct water sampling, FY2005 – Analyze water-quality/land use data, prepare water-table map/preliminary report. and develop ground-water flow model. FY 2006 – Prepare final report.

USGS