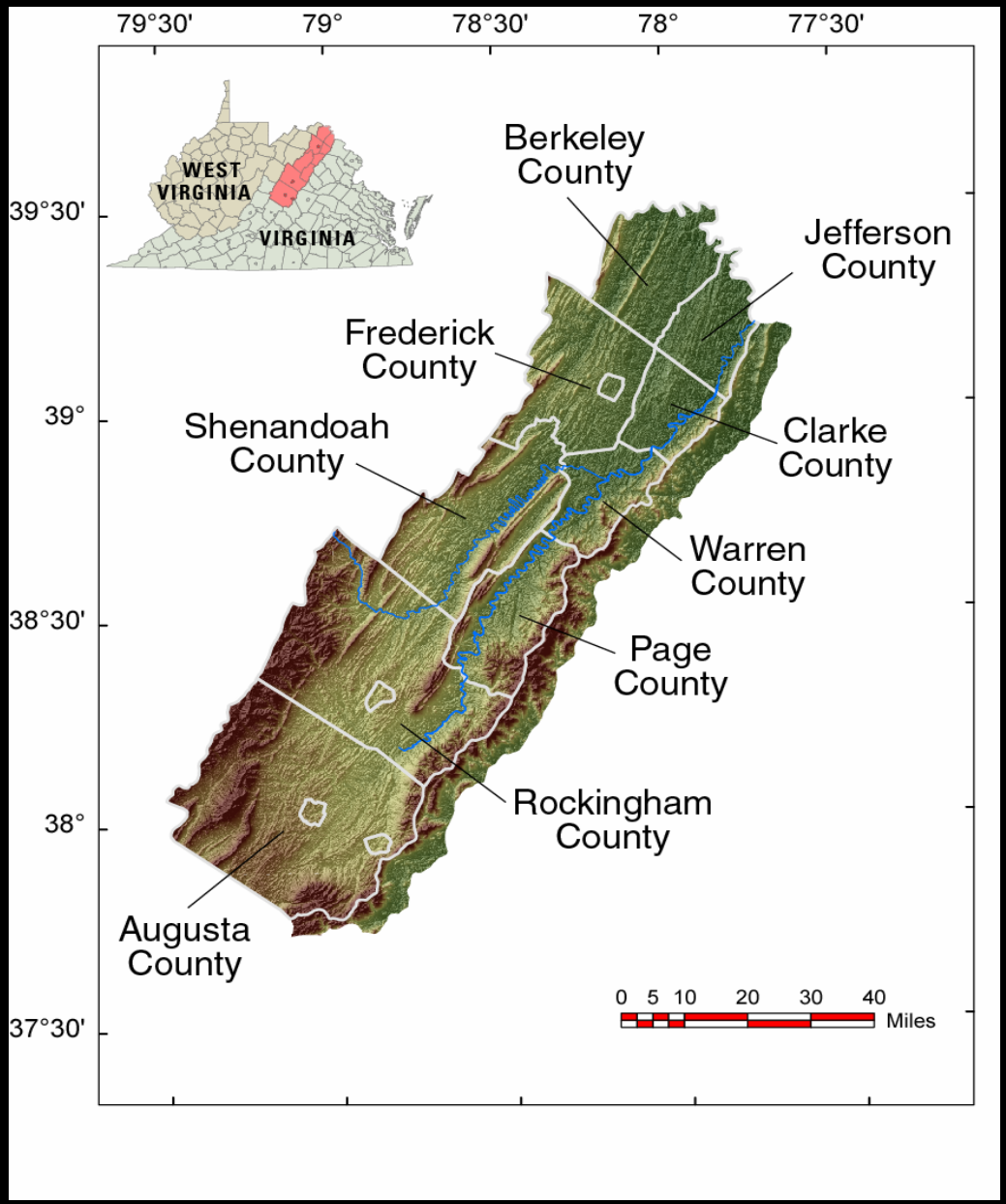
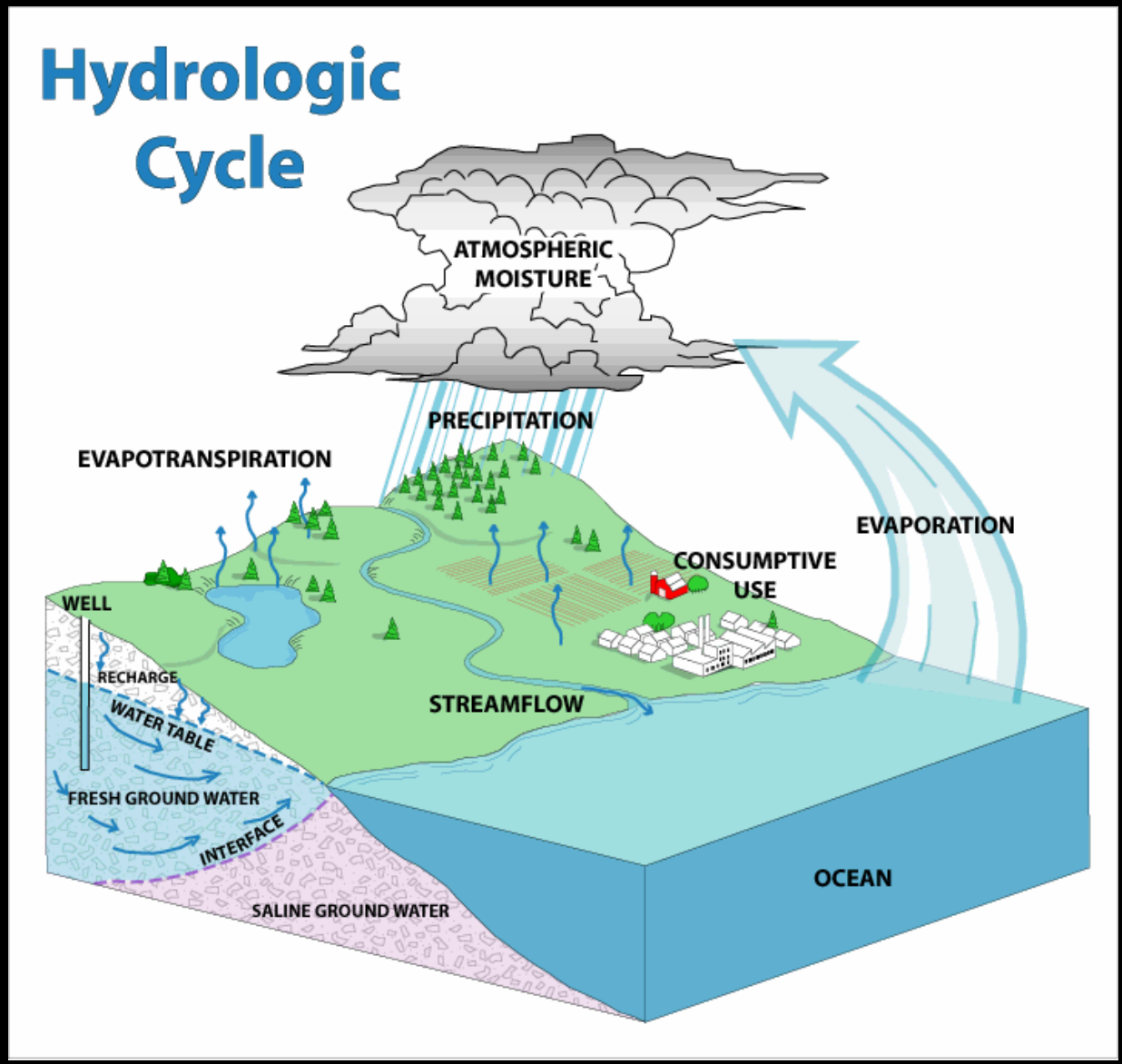
Northern Shenandoah Valley Water Resources Initiative

Frederick County Board of Supervisors and Planning Commission
May 25, 2005
Winchester, VA



Water Balance



USGS

Aquifer Material

Sand

Crystalline rock

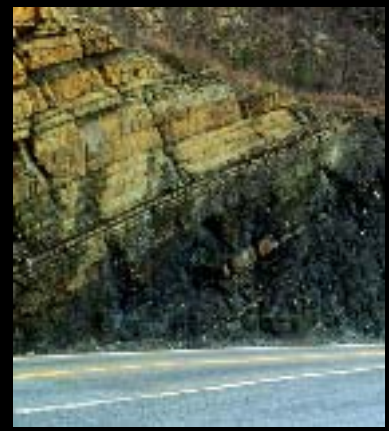
Carbonates

Shenandoah Valley

Shell material

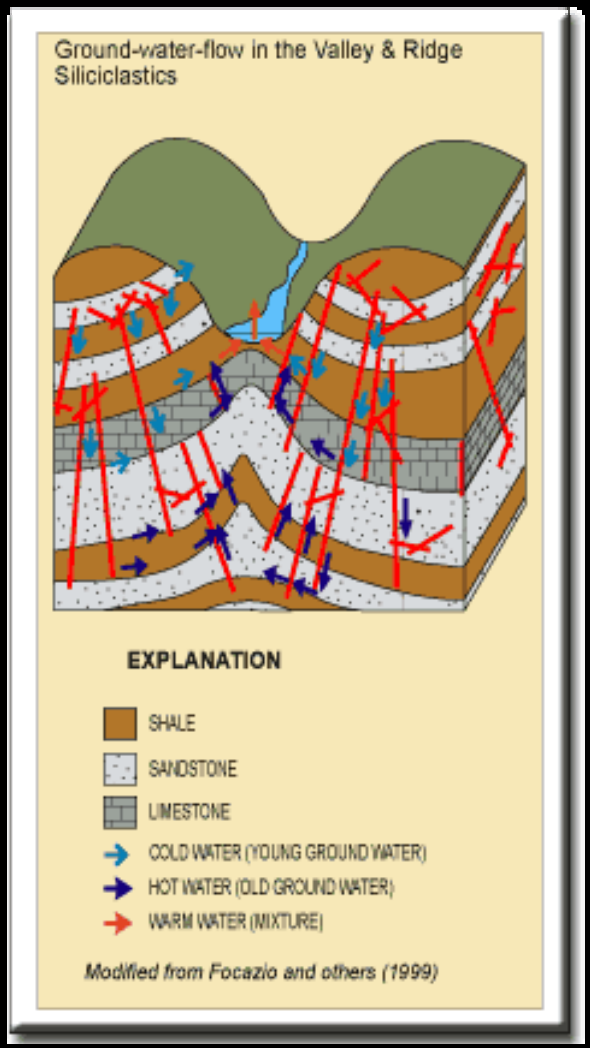
Sedimentary rock

Coal

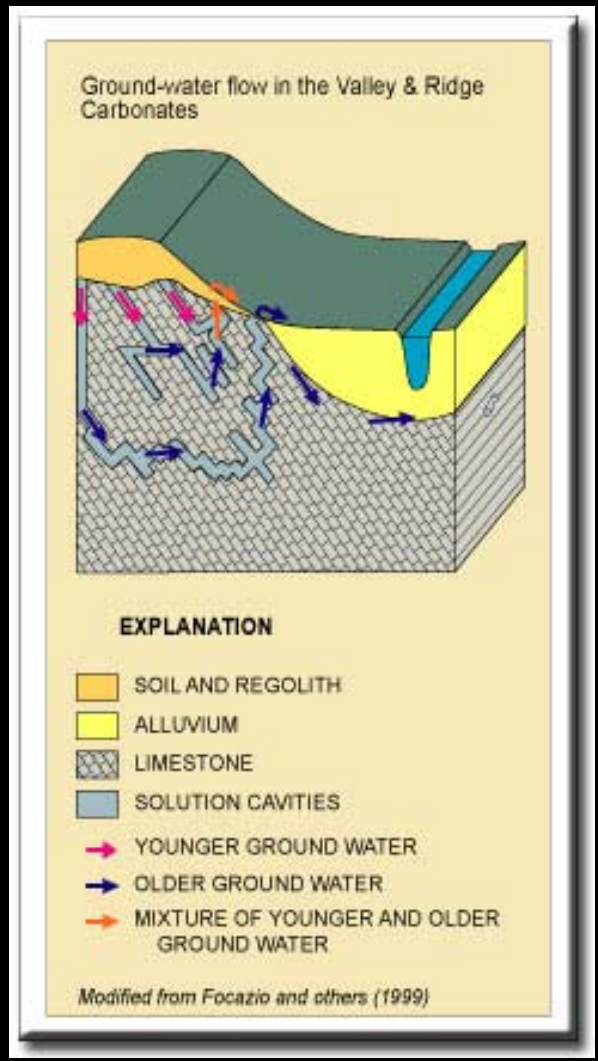


USGS

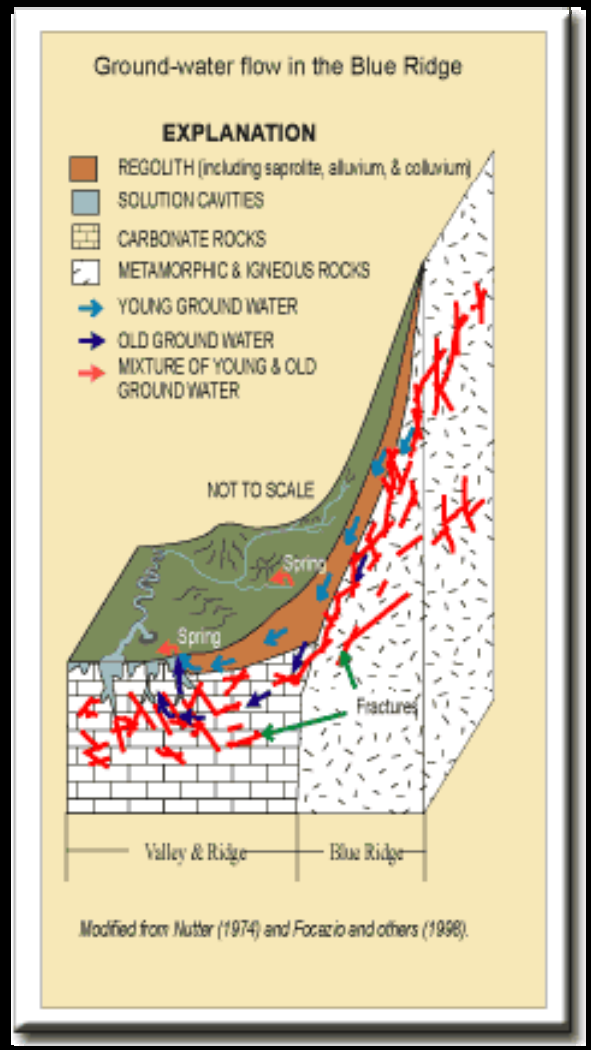
Folded & Faulted Siliciclastic Rocks



Folded & Faulted Carbonate Rocks

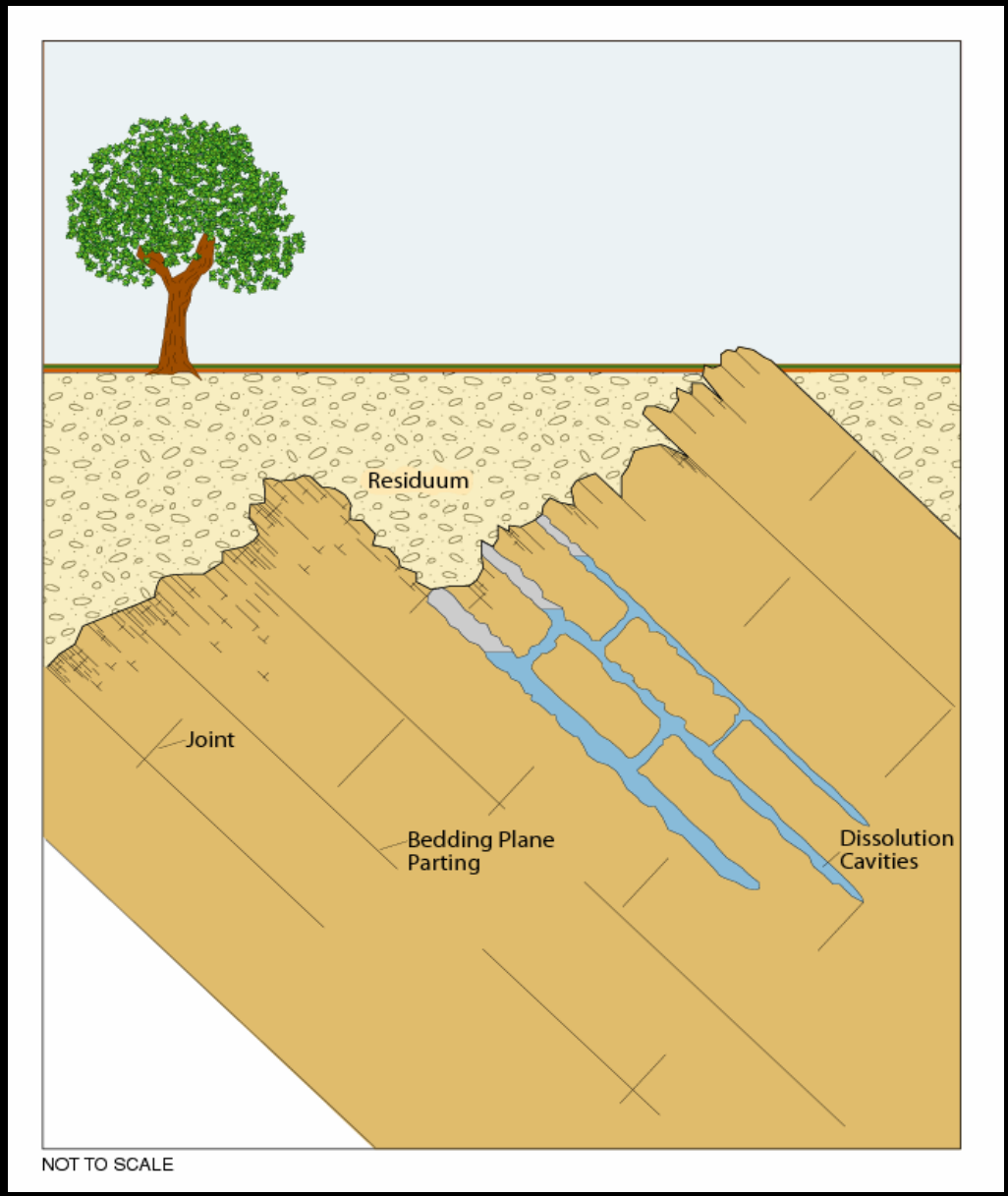


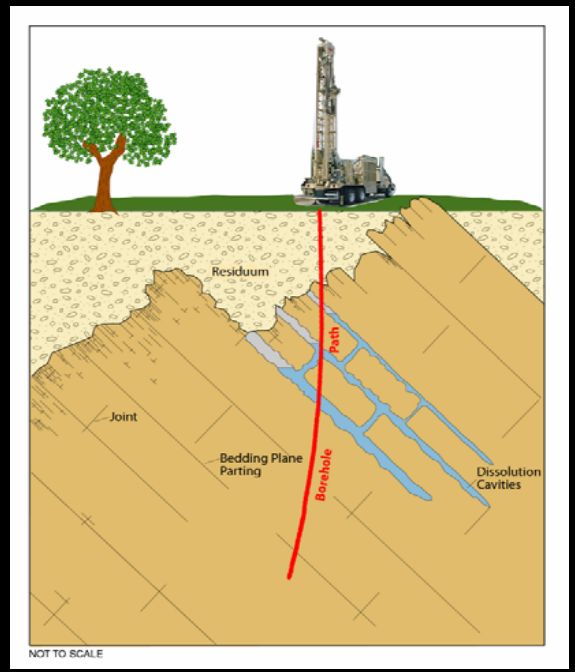
Folded & Faulted Crystalline Rocks



USGS

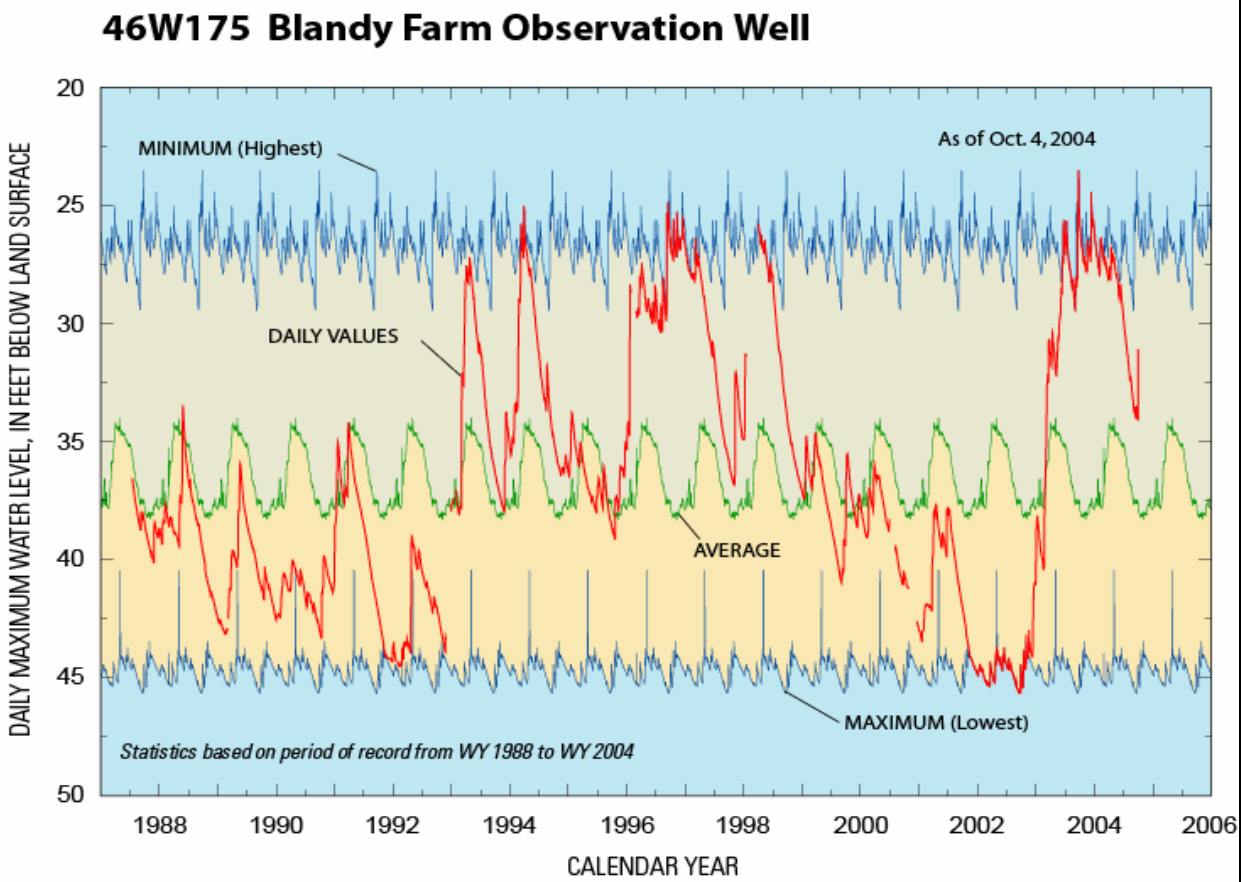
Ground-Water Flow in Karst





USGS

Long Term Monitoring—Ground Water Levels

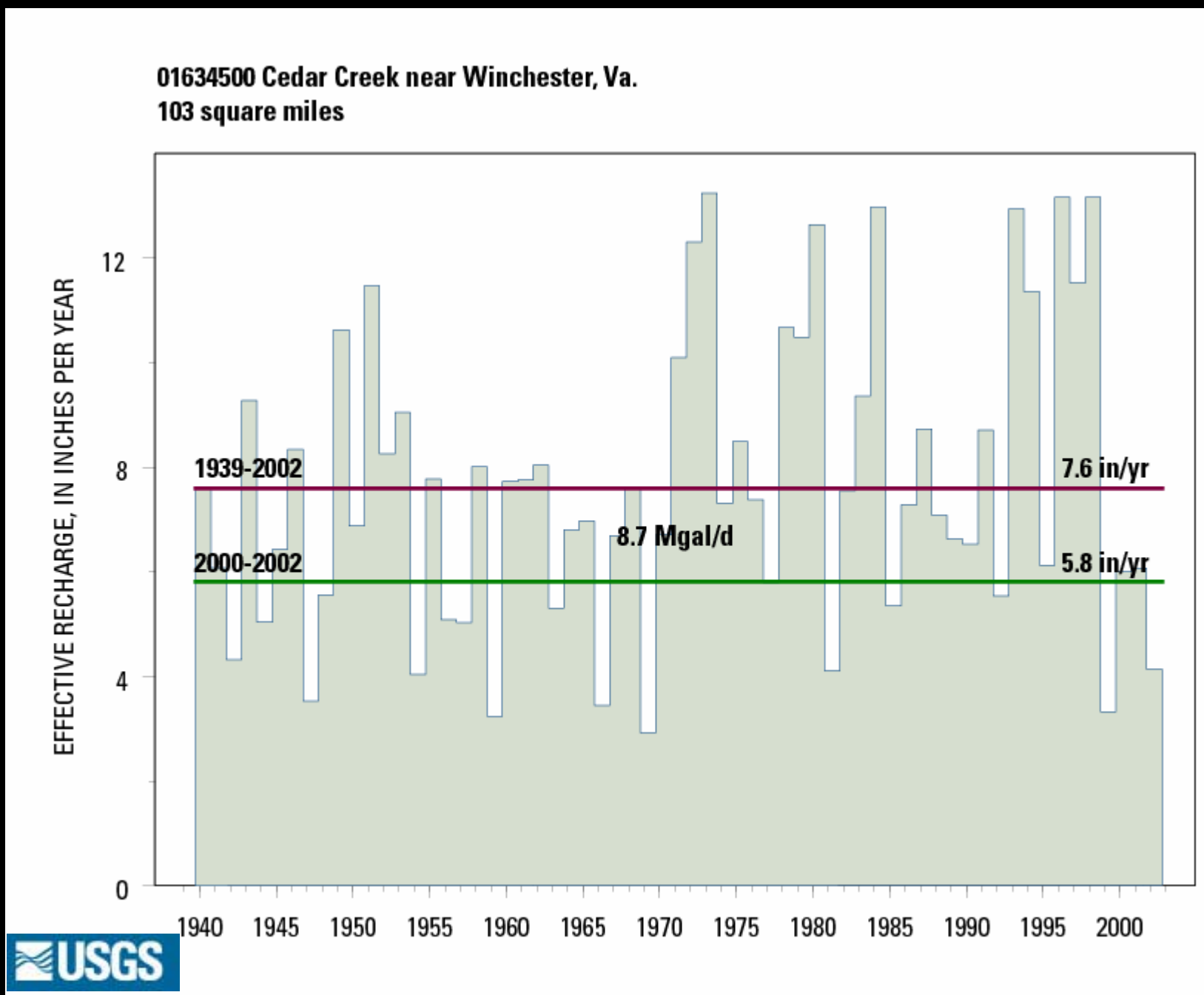


Internet Access:

Real Time Water Levels: http://waterdata.usgs.gov/va/nwis/current/?type=gw

Ground Water Climate Response Network: http://groundwaterwatch.usgs.gov/

USGS


01634500 Cedar Creek near Winchester, Va.
103 square miles
EFFECTIVE RECHARGE, IN INCHES PER YEAR
0
4
8
12
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
1939-2002
7.6 in/yr
8.7 Mgal/d
2000-2002
5.8 in/yr
USGS

Foundation Projects :

- Shenandoah River Minimum Instream Flow Investigation:
  - Main Stem – 1999
  - North Fork – 2004
  - South Fork – 2005 start
- County Studies
  - Frederick County -2001
  - Warren County – 2002
  - Clarke County – 2002
  - Berkeley County - 2002
  - Jefferson County - 2004
- Leetown Science Center Assessment - 2002

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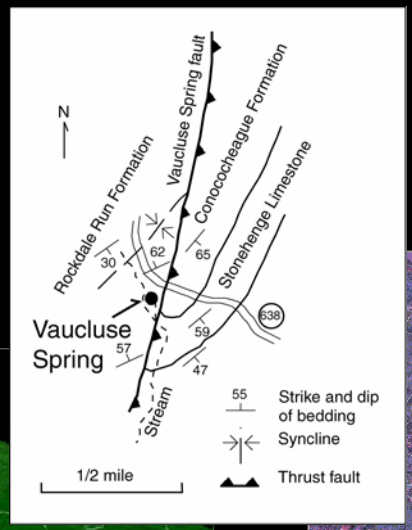
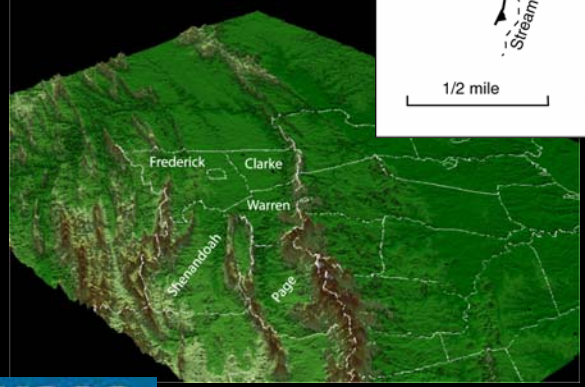
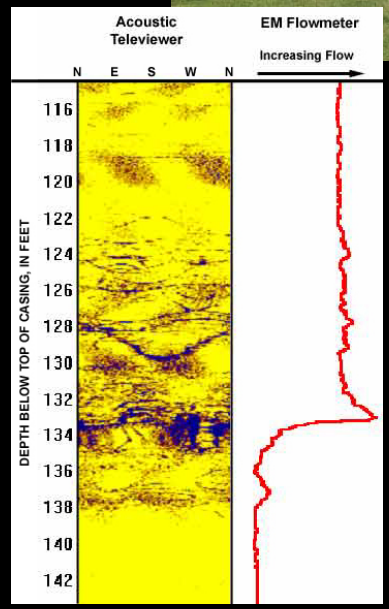
Study Approach







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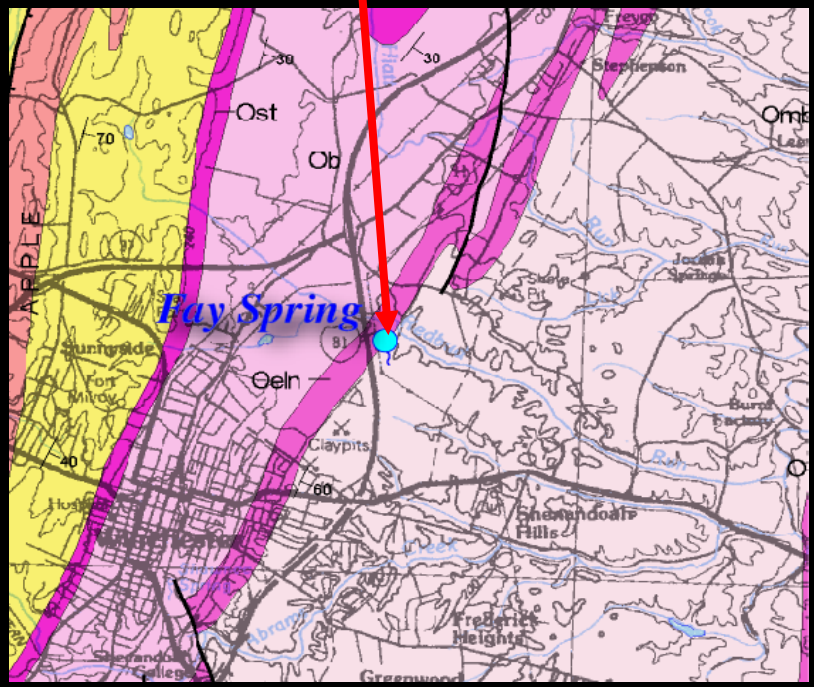
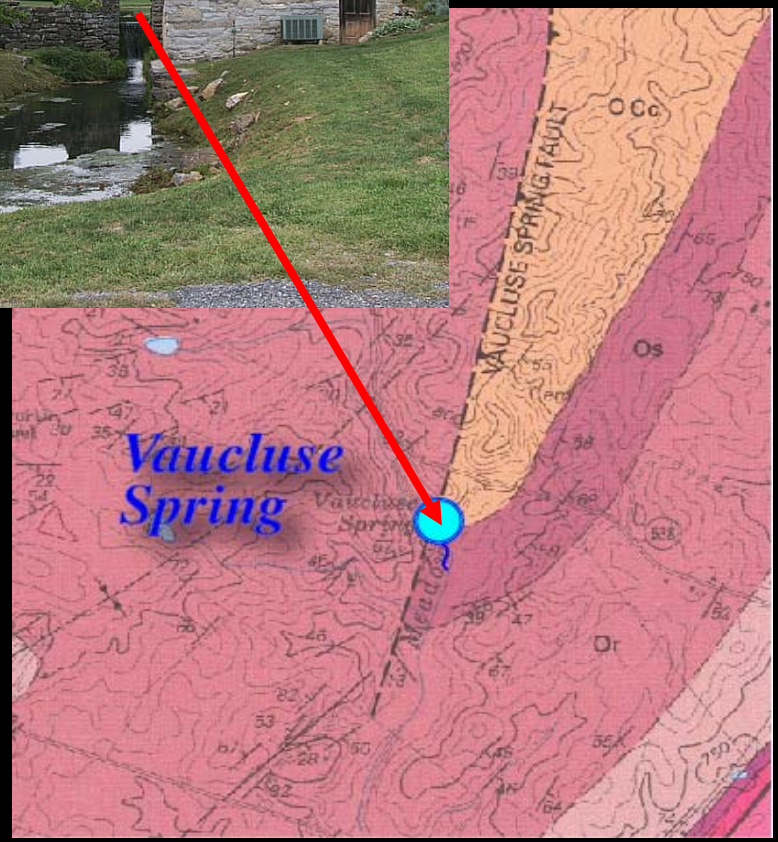
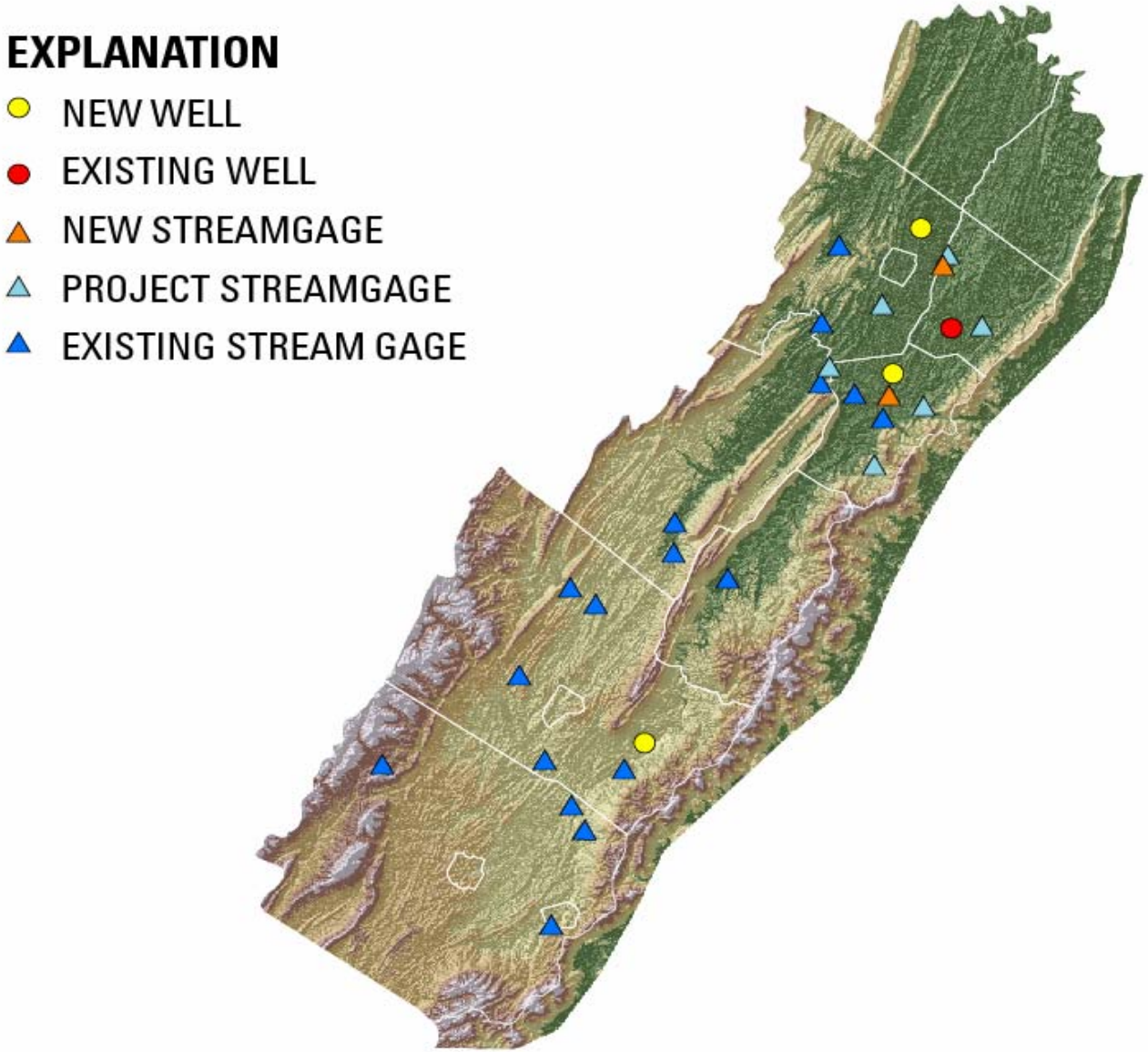
Karst Springs





Real-Time Water-Data Network



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Borehole Geophysical Logging

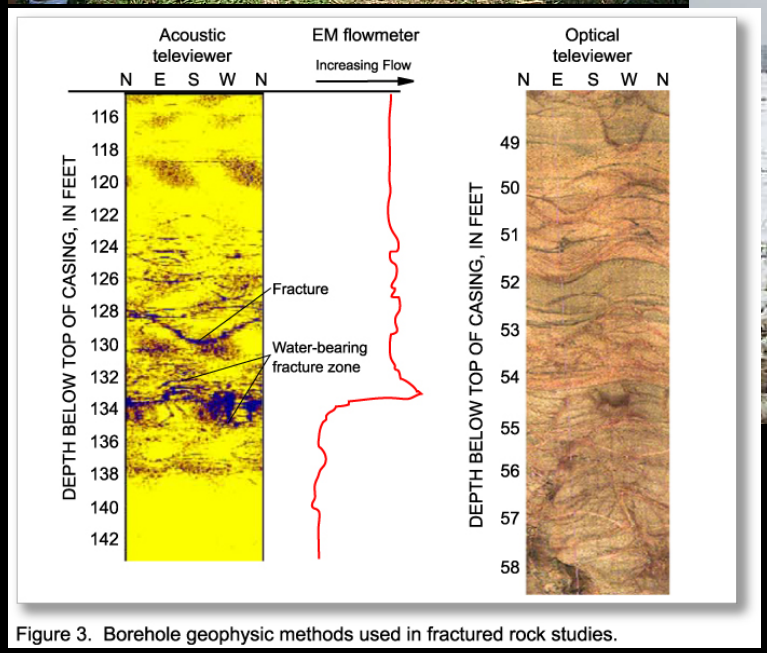

Figure 3. Borehole geophysic methods used in fractured rock studies.

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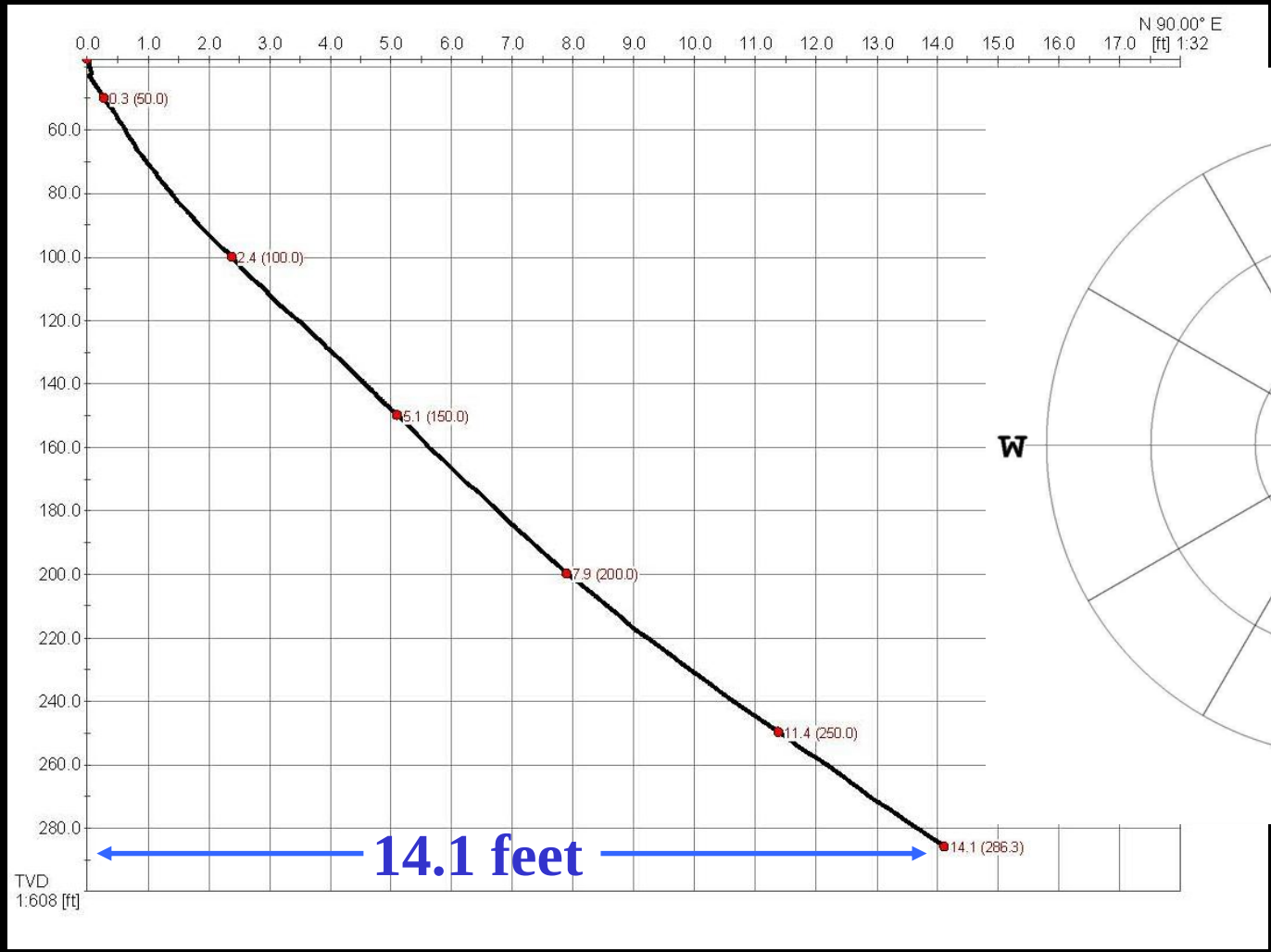
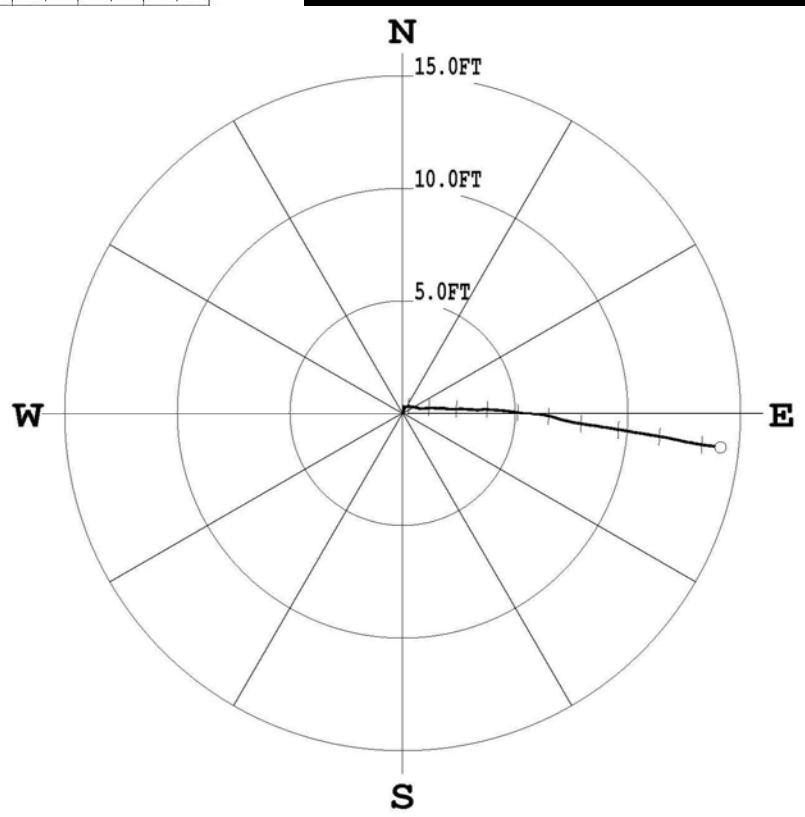
Frederick County – Well 45W 21 near Stephens City

Vertical Profile Deviation Log Plan View





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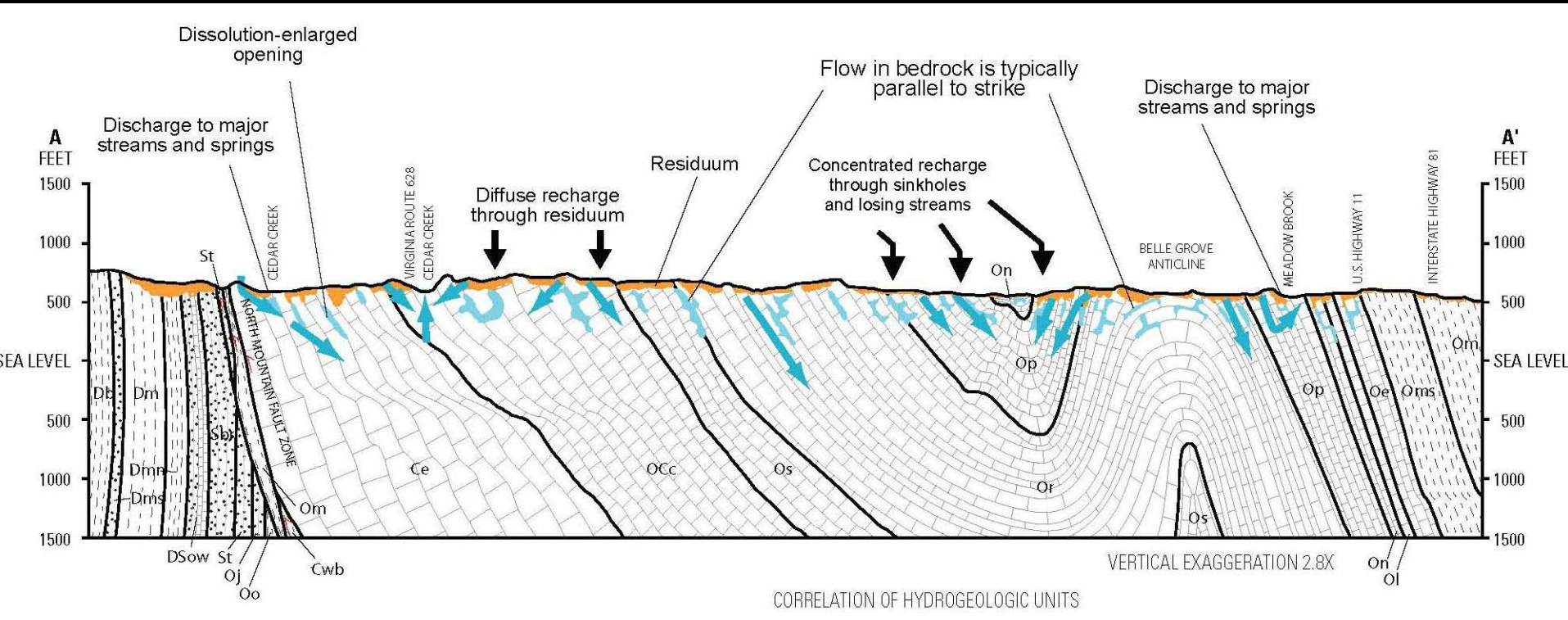
Generalized hydrogeologic section across the Frederick County carbonate aquifer system



Multidisciplinary Assessment of the Northern Shenandoah Valley in Virginia and West Virginia

- The objective of this first integrated regional assessment is to better characterize the aquifer systems in the Northern Shenandoah Valley and provide relevant hydrogeologic information that can be used to guide the development and management of these water resources.

- This regional study of the karst and fractured-rock aquifer systems will use hydrologic, geologic, cartographic, and biologic information to improve the understanding of the aquifer systems, their relationship to surface features, and potential hazards over a multi-county area of Virginia and West Virginia.

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Study Approach for Regional System:

- Characterize karst and fractured-rock aquifer systems
- Characterize ground-water/surface water interactions
- Develop numerical models to simulate the regional and local ground-water-flow systems
- Characterize water quality and sources of degradation
- Assess implications of water resources management decisions on aquatic ecosystems

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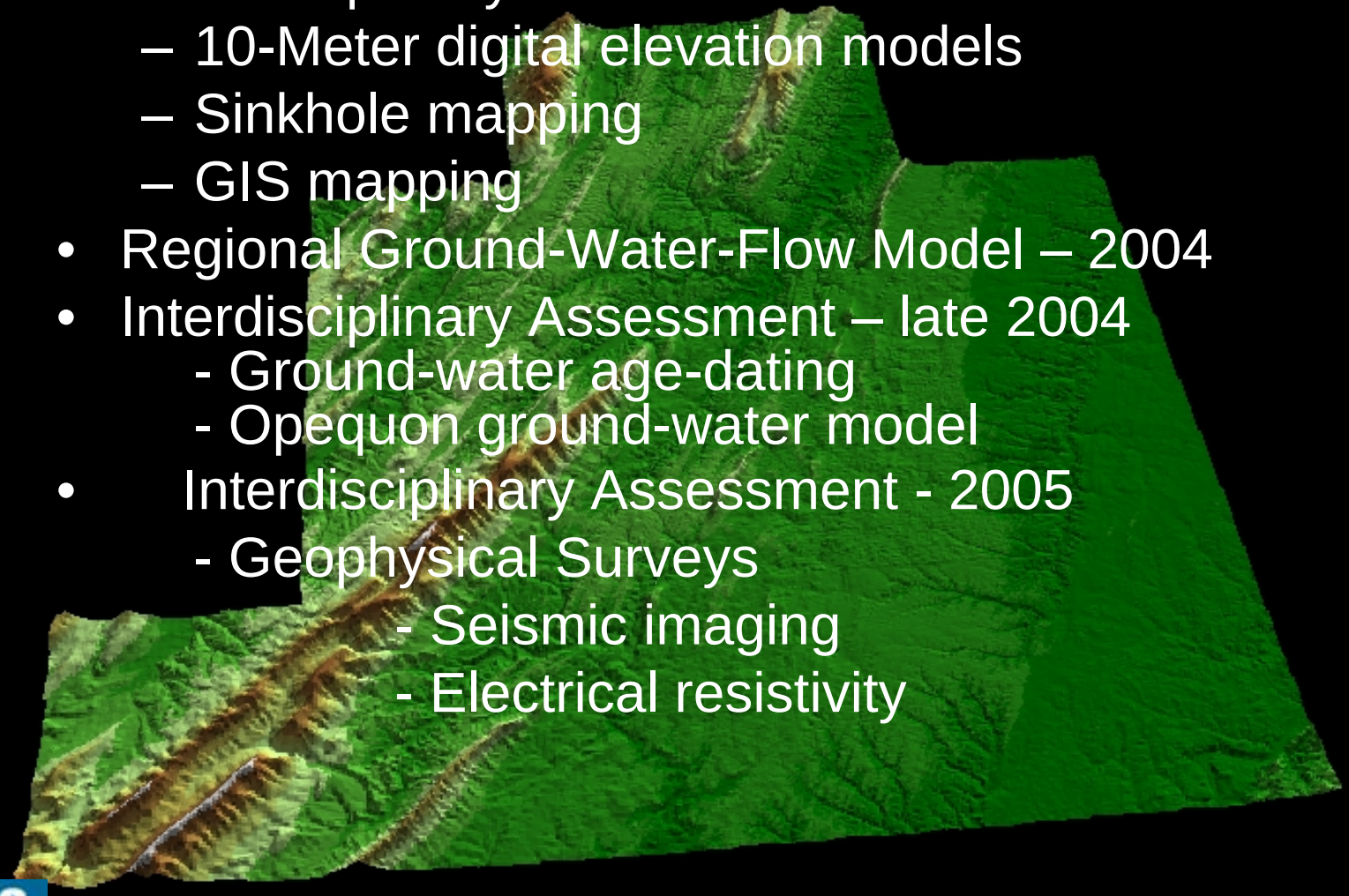
Project Elements:

- Interdisciplinary Assessment – late 2003
  - 10-Meter digital elevation models
  - Sinkhole mapping
  - GIS mapping
- Regional Ground-Water-Flow Model – 2004
- Interdisciplinary Assessment – late 2004
  - Ground-water age-dating
  - Opequon ground-water model
- Interdisciplinary Assessment - 2005
  - Geophysical Surveys
    - Seismic imaging
    - Electrical resistivity



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Sinkhole Mapping

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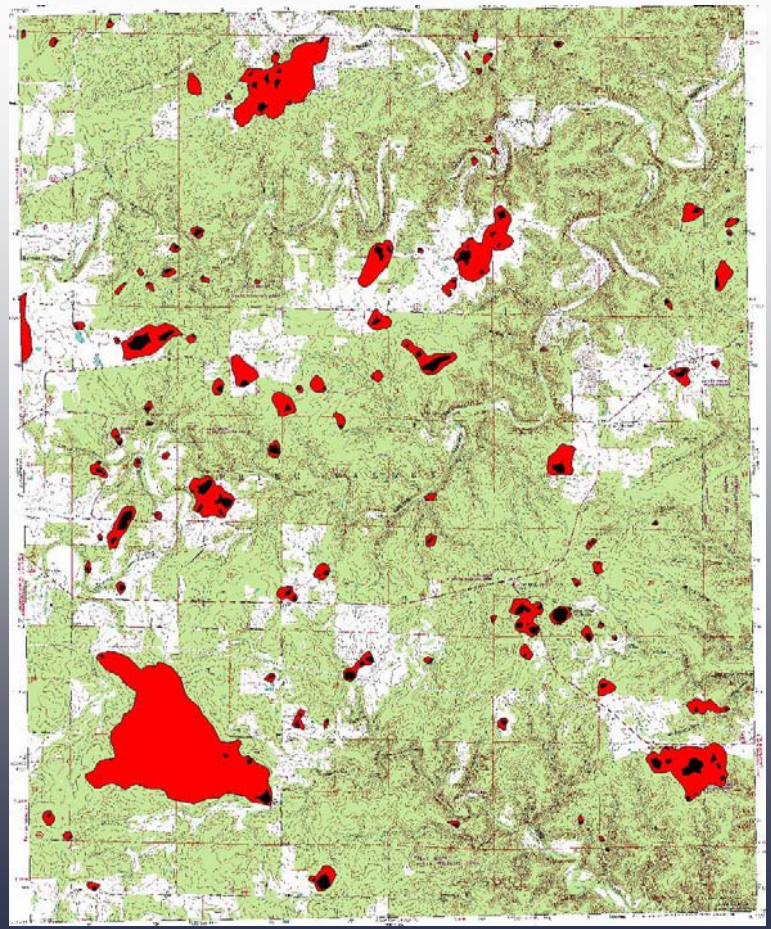
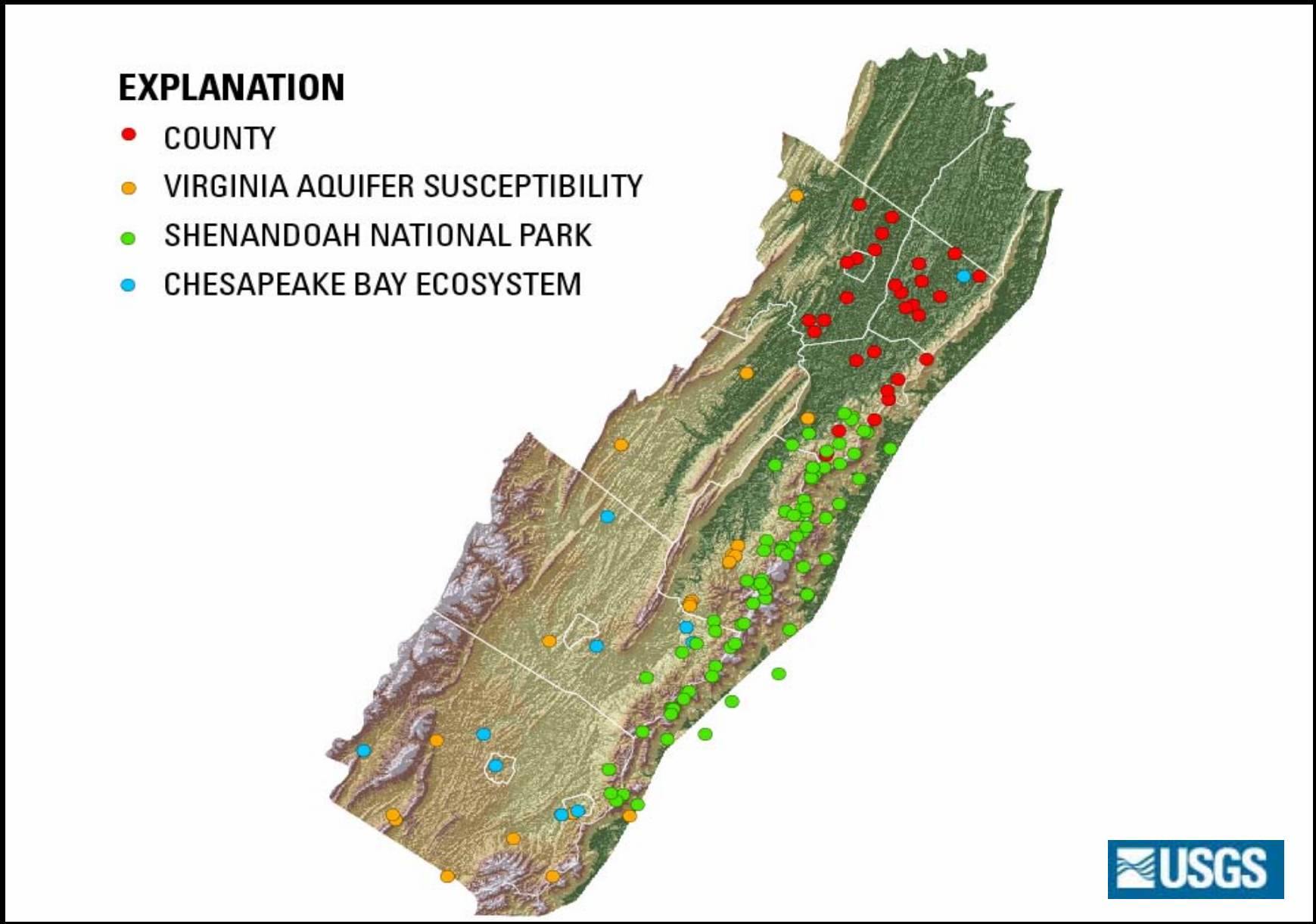


Sinkholes
(789,345 sq meters, 0.5% of area)

Area drained by sinkholes
(9,017,287 sq meters, 5.86% of area)

Ground-Water Age Dating



Ground-Water-Age Dating: Perry Spring

Tritium (*^3H*)	7.5±0.5	*TU*
Helium (*2.1*)	4.3	*NanoMol/L*
Hydrogen (*0.4*)	2.4	*NanoMol/L*
Neon (*9*)	12.2	*NanoMol/L*
Deuterium	-53.1	per mil
Oxygen-18	-8.4	per mil
***d*Excess**	13.8	per mil

Oxygen, diss.	5.2	*mg/L*
pH	6.7	
Spec. Cond	659	*uS/cm*
Water Temp	12.5	*Celsius*
Rech Temp	9.5	Celsius
Excess air	5.2	cc STP/L
Rech Elev	560	ft above Sea Level

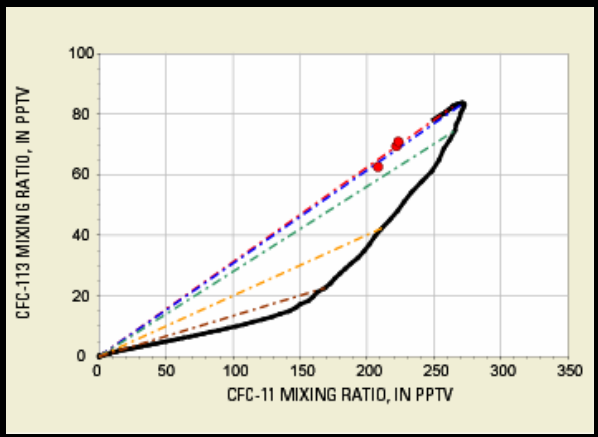
3.0

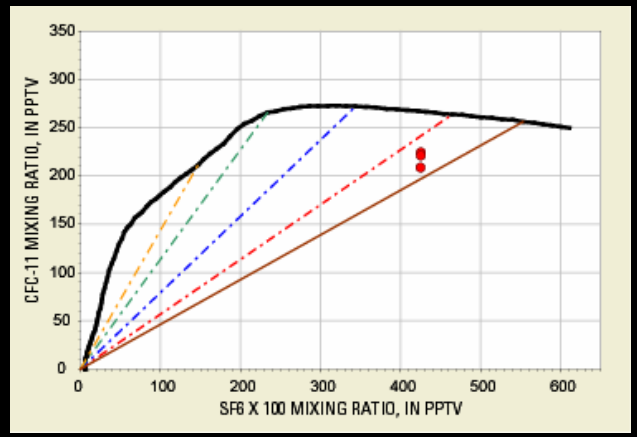
EXPLANATION

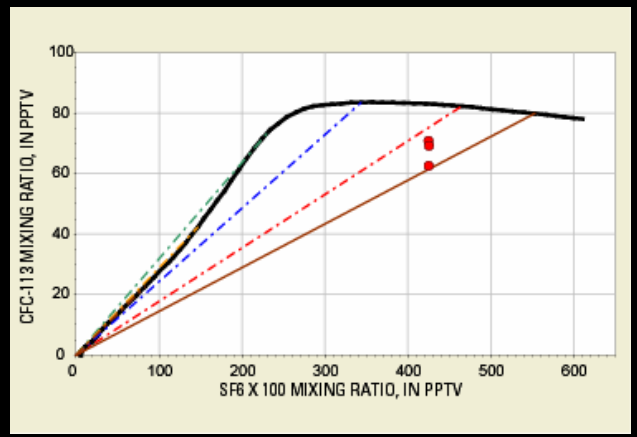
- Piston Flow

Binary mixture of old (pre-CFC) with

- 1980
- 1985
- 1990
- 1995
- 2000
- 2003.5 (Sample period)







Binary Mixture:

85% - 2 year water

15% - pre-CFC water

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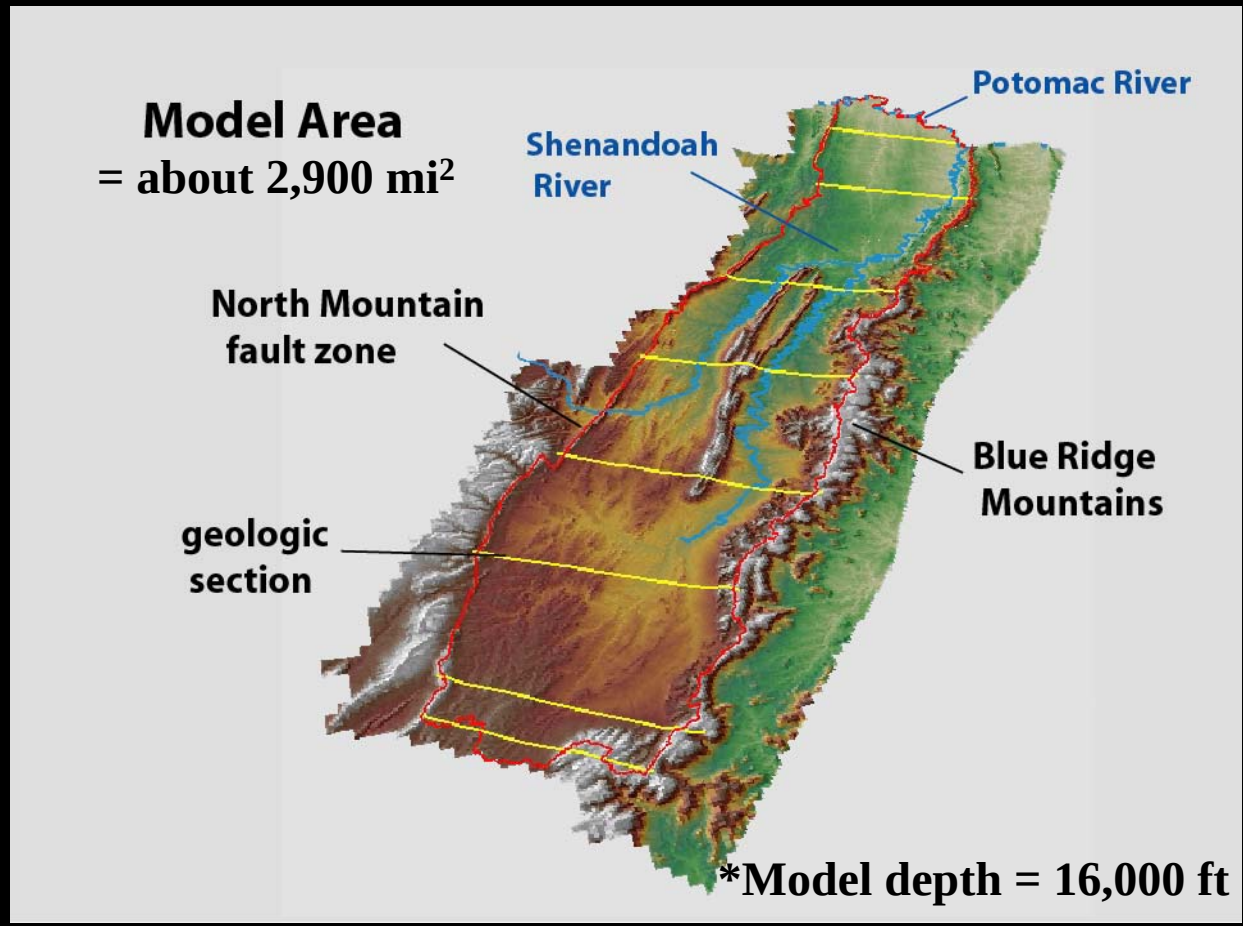
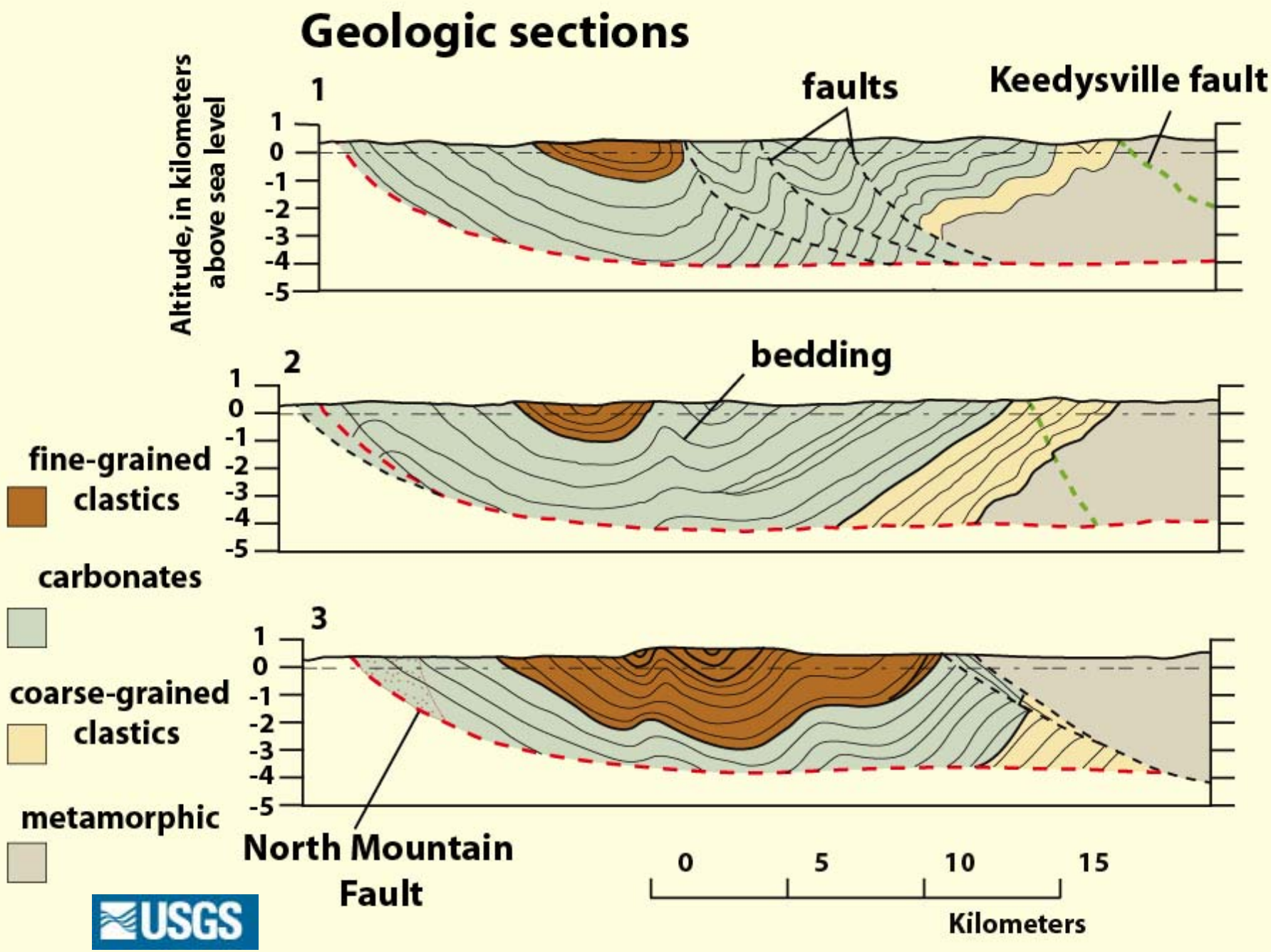
Ground-Water-Flow Model of the Shenandoah Valley

Richard Yager
USGS
Ithaca, New York

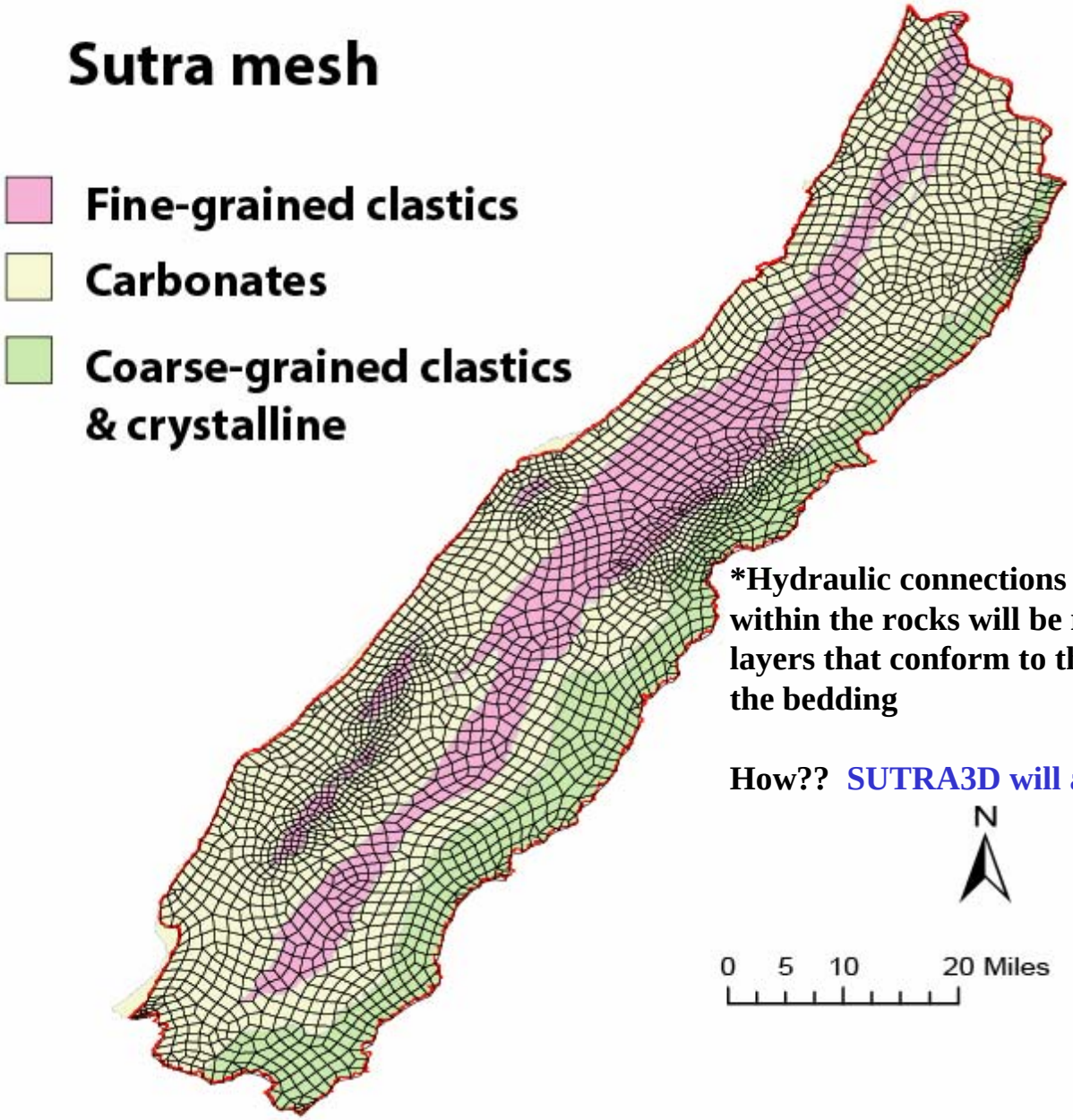


Objectives:

-Compute water budget
-Estimate bulk hydraulic properties
-Identify data requirements


Geologic sections
Altitude, in kilometers above sea level
1
2
3
faults
Keedysville fault
bedding
North Mountain Fault
1
0
-1
-2
-3
-4
-5
fine-grained clastics
carbonates
coarse-grained clastics
metamorphic
0
5
10
15
Kilometers
USGS

Sutra mesh



***Hydraulic connections along bedding planes within the rocks will be represented by model layers that conform to the generalized dip of the bedding**

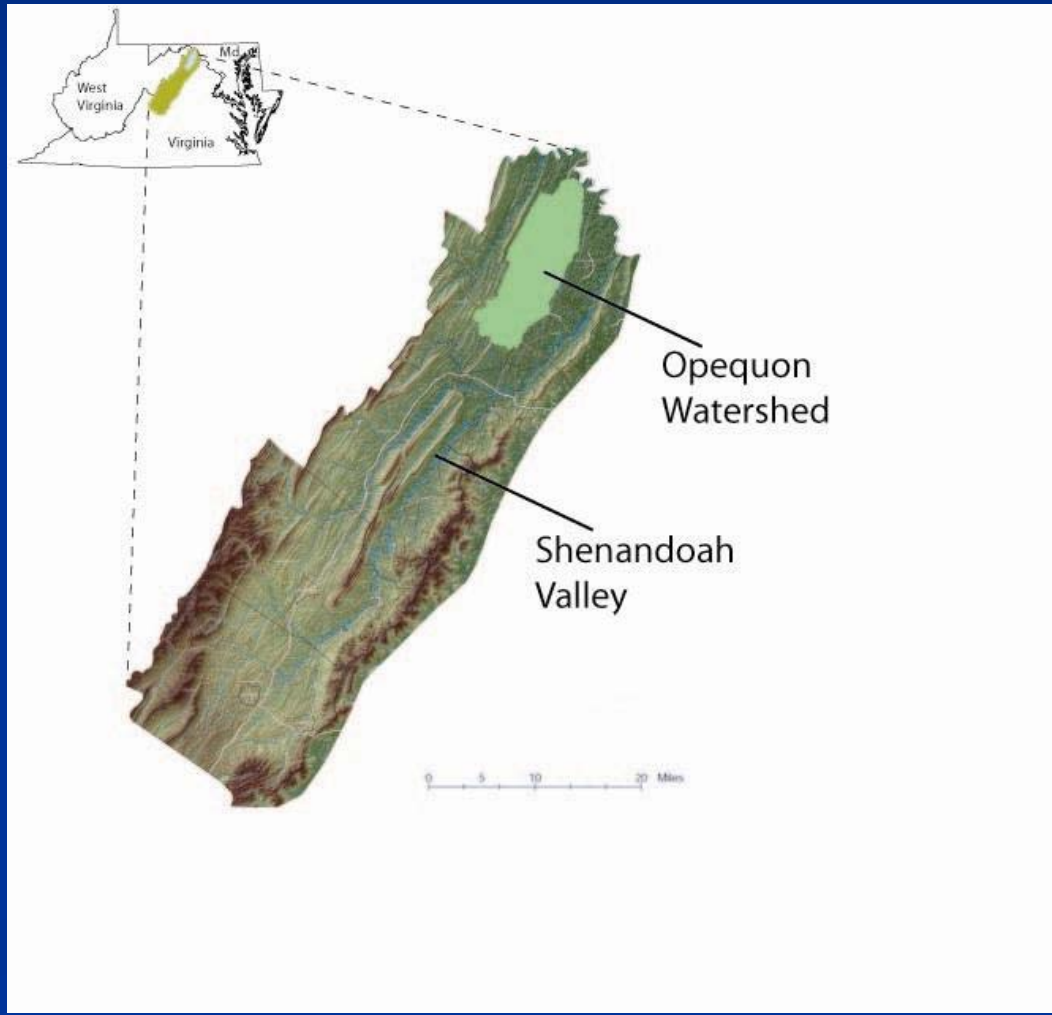
How?? SUTRA3D will allow this!

Opequon Creek Ground-water Simulation Model

-

West Virginia & Virginia

Jack Eggleston
USGS, Richmond, VA



Goals of Study

Better understand the regional hydrologic system:

- What is the available ground-water supply?
- How do streams and groundwater interact?
- How does drought affect streams/springs/gw?
- How will population growth affect hydrology and water availability?

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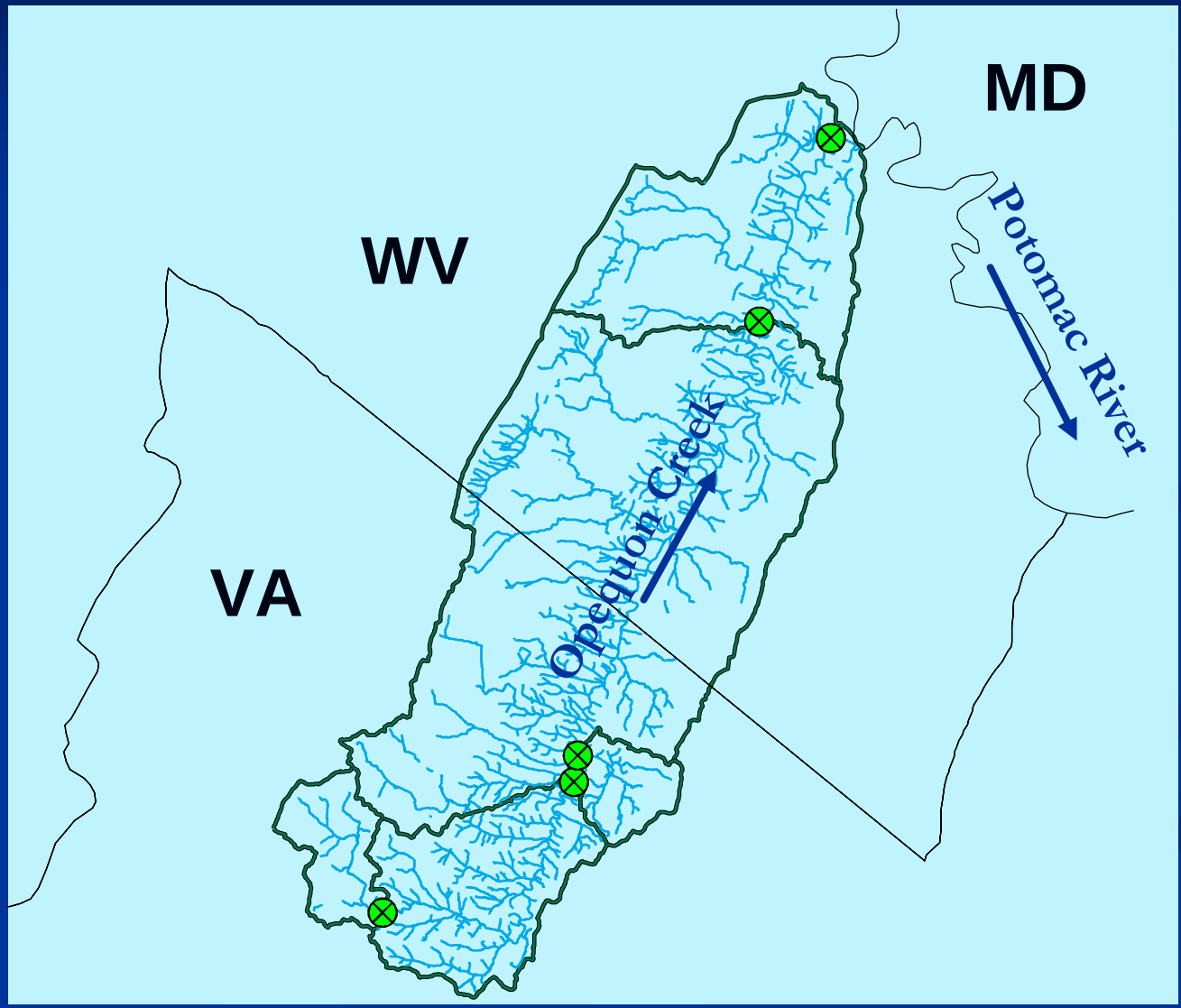
Opequon Stream Network



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Opequon Streamflow

- Base flow is the portion of stream flow that comes from groundwater discharge
- 68% of Opequon Creek flow is base flow (*Martinsburg WV gage, annual average 1948-2002*)
- The groundwater model will simulate base flow in streams.
- The model will be calibrated using base-flow data from the five stream-gaging stations.

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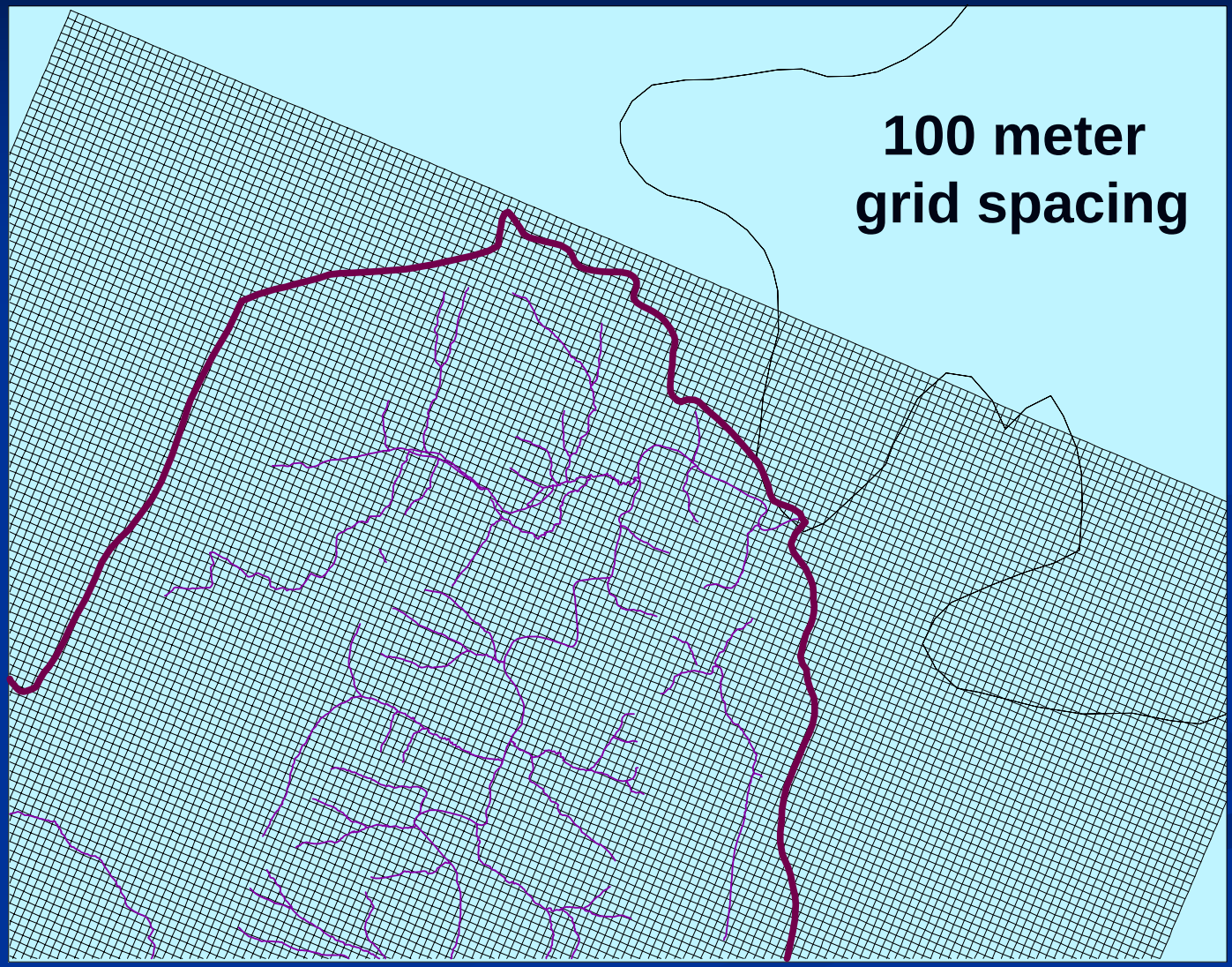
Model Grid



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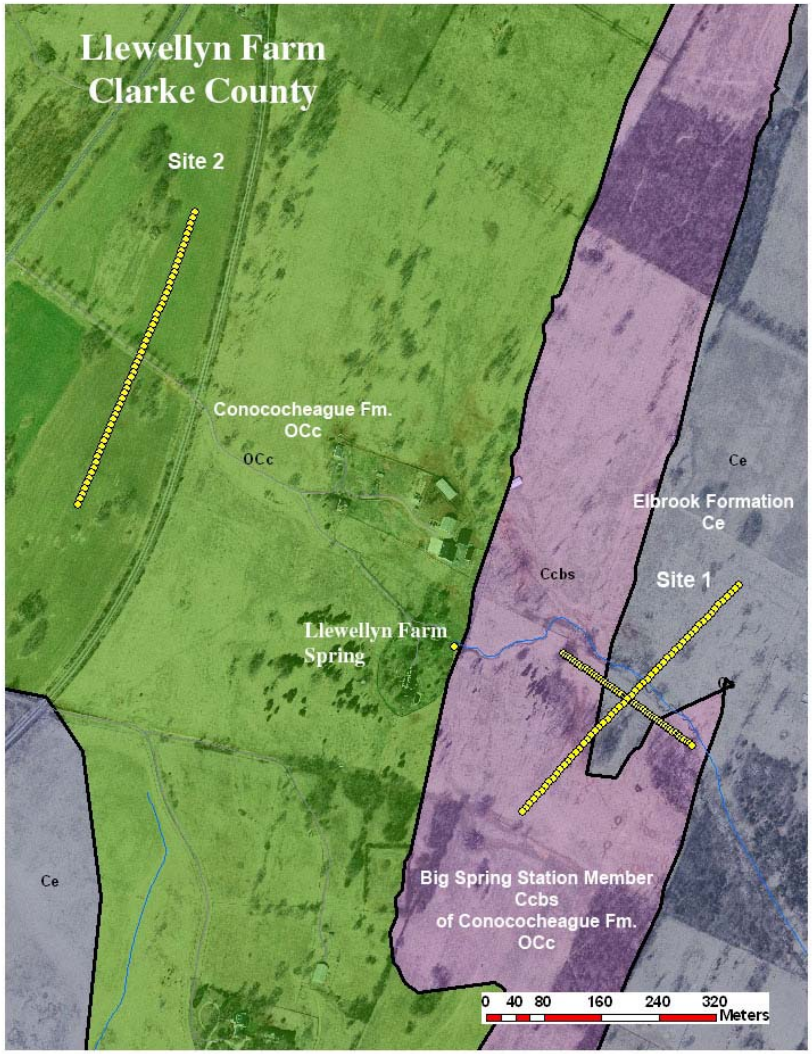
Surface Geophysical Techniques



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Internet Sites

- **Water Resources of Virginia**

  http://va.water.usgs.gov/

  - Frederick County Project

    http://va.water.usgs.gov/projects/va134.html

  - Clarke County Project

    http://va.water.usgs.gov/projects/va146.html

  - Warren County Project

    http://va.water.usgs.gov/projects/va142.html

  - Shenandoah River Minimum Instream Flow Project

    http://va.water.usgs.gov/projects/va111.html

- **Great Valley Water-Resources Science Forum**

  http://va.water.usgs.gov/GreatValley/Index.htm

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