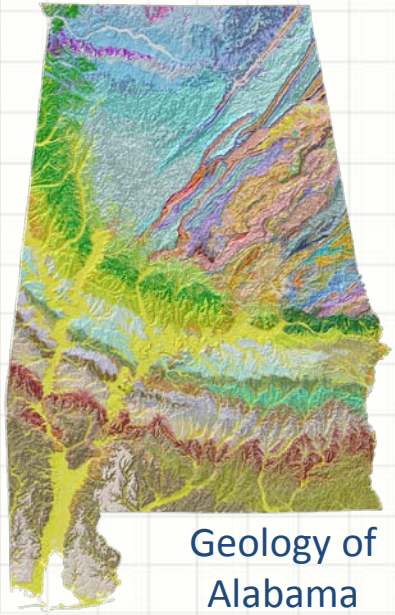
# WATER RESOURCE MANAGEMENT AND POLICY DEVELOPMENT: DON'T PUT THE CART BEFORE THE HORSE

**Marlon Cook**

**Groundwater Assessment Program**



Geology of Alabama

# QUESTIONS RELATED TO GROUNDWATER RESOURCE MANAGEMENT AND POLICY DEVELOPMENT?

- How much groundwater do we have and where is it located?
- How much groundwater are we currently using and how much will we need for future demand?
- How much groundwater can we produce sustainably in any specified area and are there currently areas in the state that are overproducing ?
- Is groundwater production impacting surface water bodies and base flow volumes?
- What are proper well spacings and maximum sustainable production rates?
- What is the contribution area for a sustainably producing well?
- What will be state policy related to ownership of groundwater?
- Will there be priority uses of groundwater?

## Effective statewide water management is founded on a number of integrated components that include:

### Acquisition of fundamental water resources data including:

Water Availability Assessments—Determine how much water of sufficient quality is available from surface and groundwater sources, current impacts of water production, quantities of sustainable yield, and strategies for future water source development.

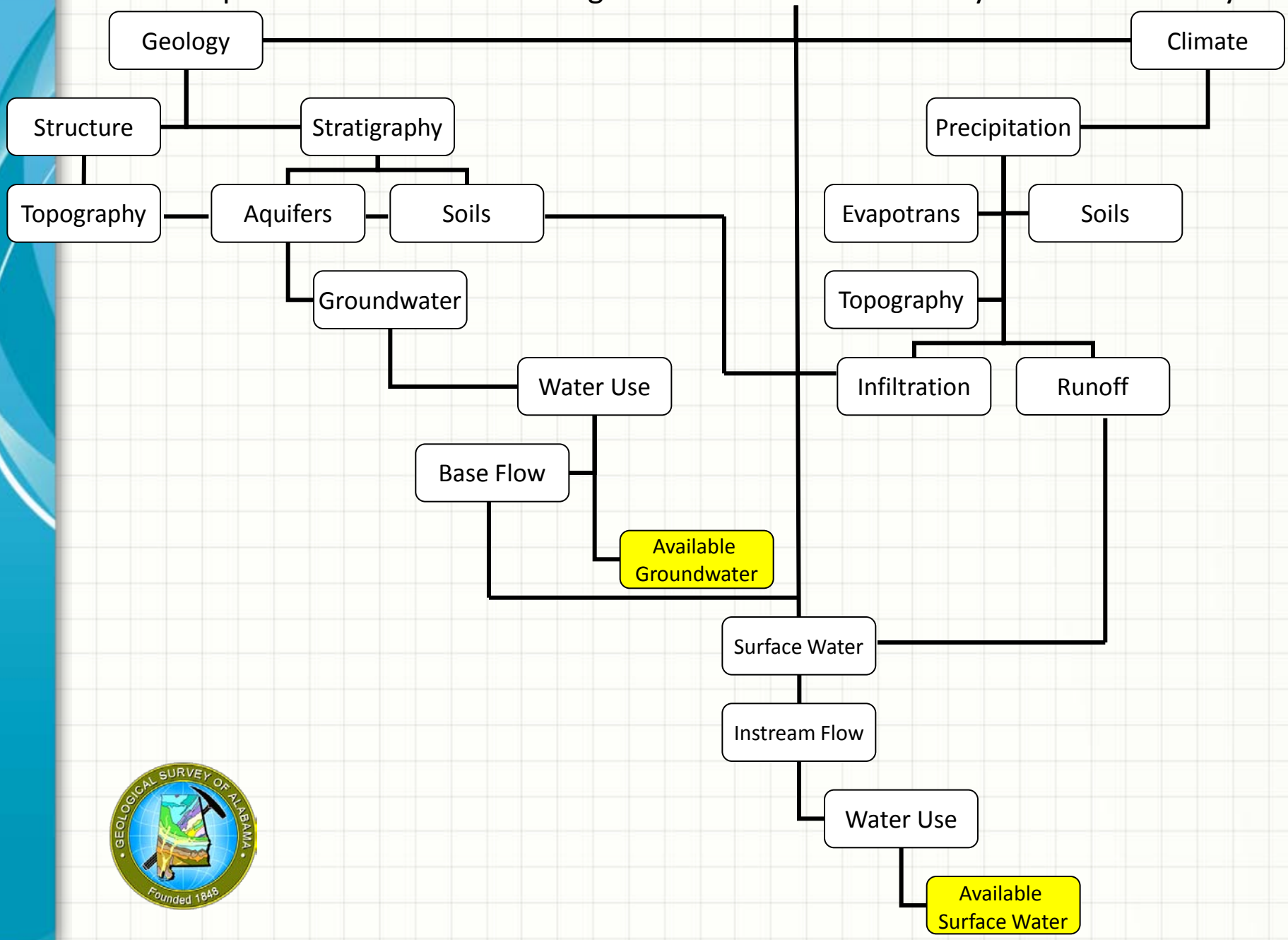
Consumptive Water Use Assessments—Determine how much water is currently used in specified sectors of society, how much water is returned to the environment, forecasts of future water use, and strategies for more efficient water production and use.

Conservation Flow Assessments—Determine how much water should remain in surface channels to support fish and wildlife and the functions of natural hydrologic systems, and impacts of current and future climate and water production.

### Establish statewide surface-water and groundwater monitoring networks including:

A comprehensive water resource monitoring network
comprised of strategically located real-time groundwater, surface-water, and precipitation monitoring systems, periodic groundwater monitoring, designed to assess climate and water production impacts.

# Interdependent Factors Controlling Water Resource Availability and Sustainability



## HYDROGEOLOGIC COMPONENTS

- **Well location maps** (water wells and oil and gas production and test wells will be sources of data for investigations).
- **Net aquifer productive interval isopach maps** for all major coastal plain aquifers (net aquifer productive interval isopach maps indicate depositional trends and the water bearing potential of geologic units).
- **Structure maps** (elevation of the top of each assessed aquifer and location of geologic structures that influence water occurrence including fault and fracture identification. Structural investigation will include geophysical log analysis, gravity and magnetics, and seismic acquisition and interpretation).
- **Stratigraphic analyses** including mapping and cross sections (includes geophysical log evaluation, well sample analysis, and seismic interpretations).
- **Potentiometric surface/water table, and residual drawdown maps** (indicates groundwater flow paths, production impacts, and climatic impacts)
- **Probable water yield maps** (based on available aquifer test data).
- **Aquifer recharge estimates** (quantitative estimate of recharge for each assessed aquifer including stream base-flow assessments and character of surface- ground-water interaction).
- **Groundwater storage estimates** (quantitative estimate of in-situ water storage in individual aquifers.
- **Ground-water production impact maps** (indicates production stress on each assessed aquifer based on water levels and well contribution area models).

## GEOCHEMICAL COMPONENTS

- Available and acquired geochemical data assessment and interpretation.
- Chloride concentration maps for each assessed aquifer.
- Iron concentration maps for each assessed aquifer.
- Maps of additional chemical constituents that may affect local water usability (includes nutrients and metals).
- Water type map for each aquifer (indicates geochemical character, evolution, water migration history, and recharge characteristics based on major ions).
- Water age date map (carbon 14 or other applicable dating technique to determine residence and recharge time).

Artisian well near Eutaw
GSA Photo Archive

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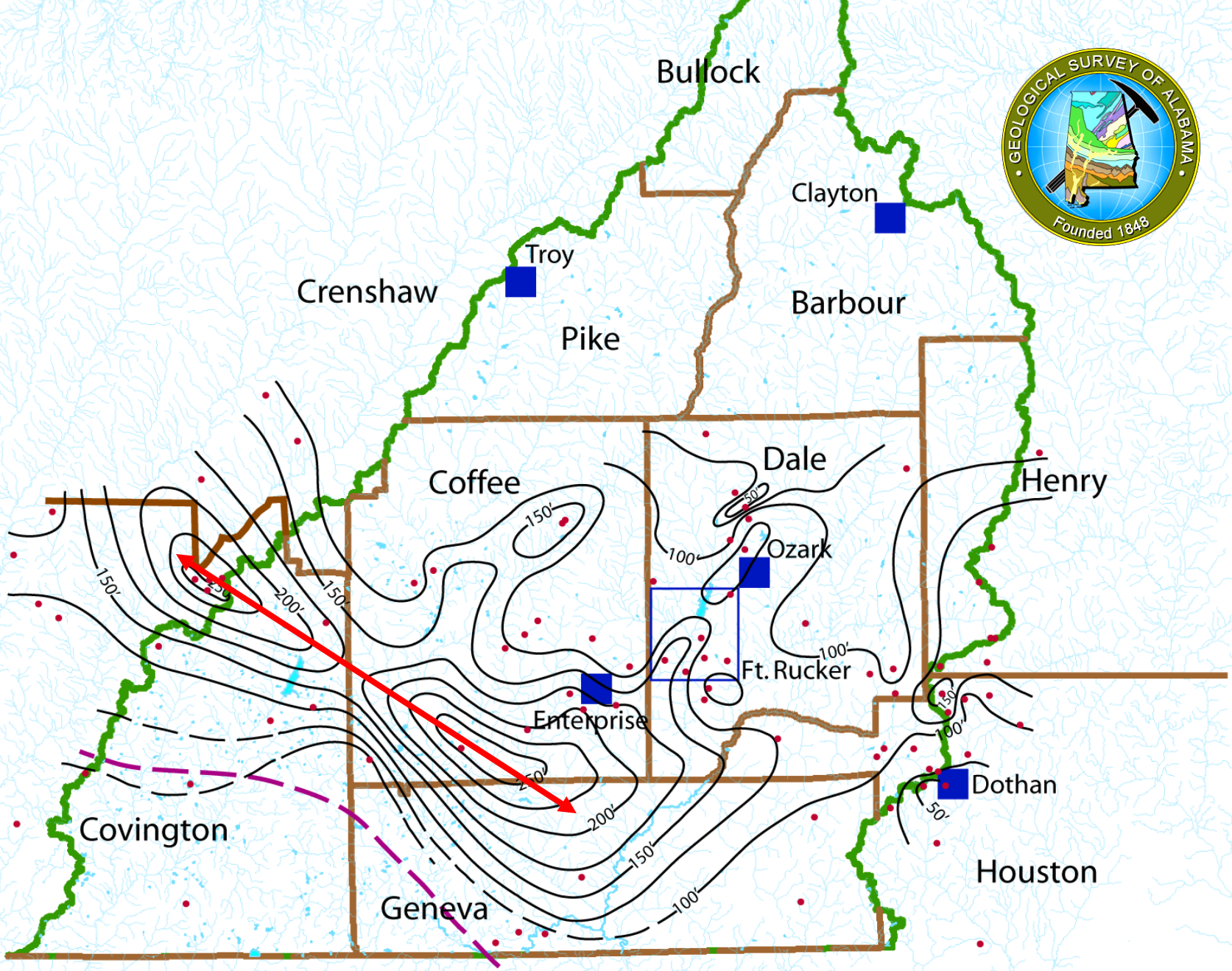
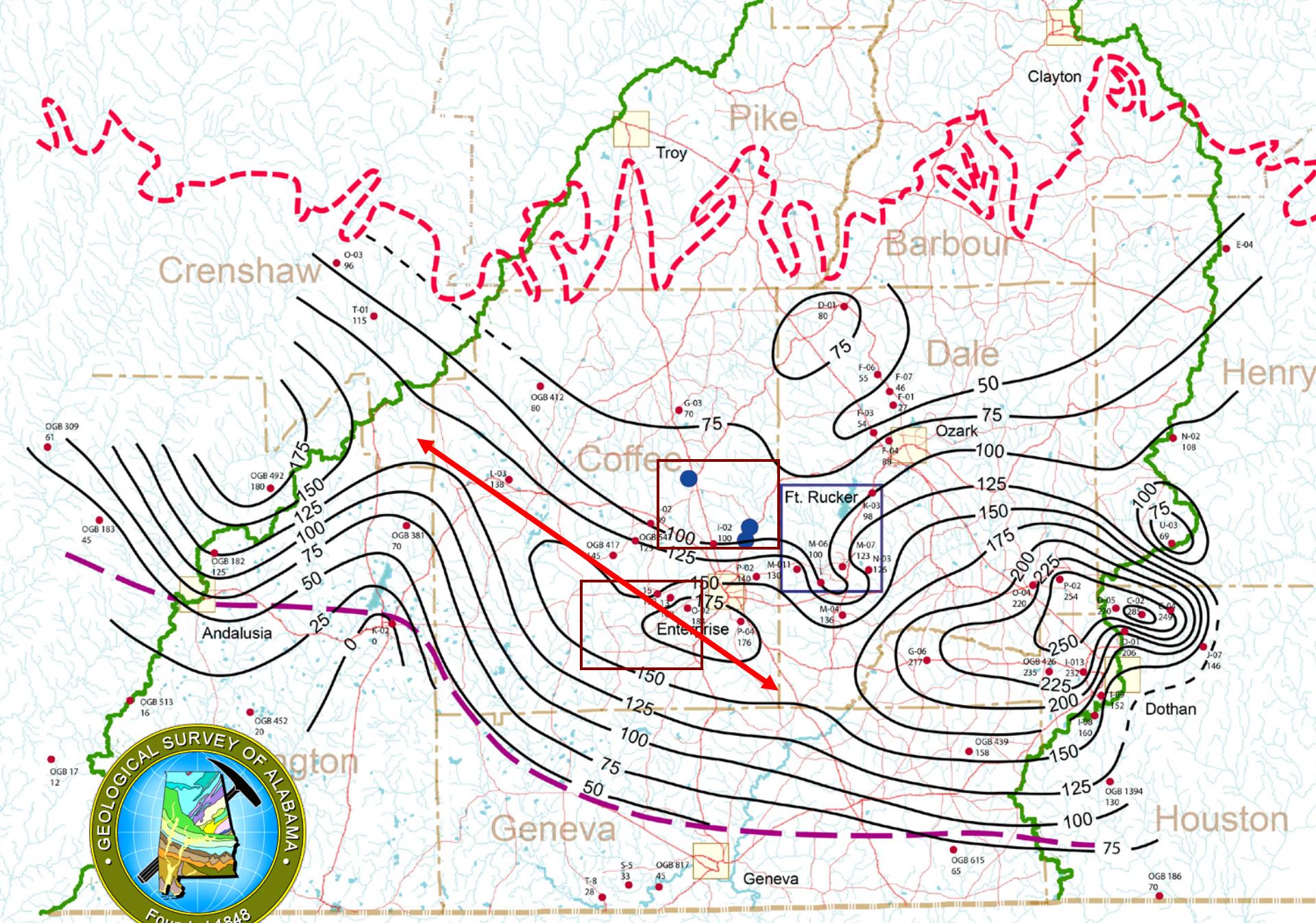
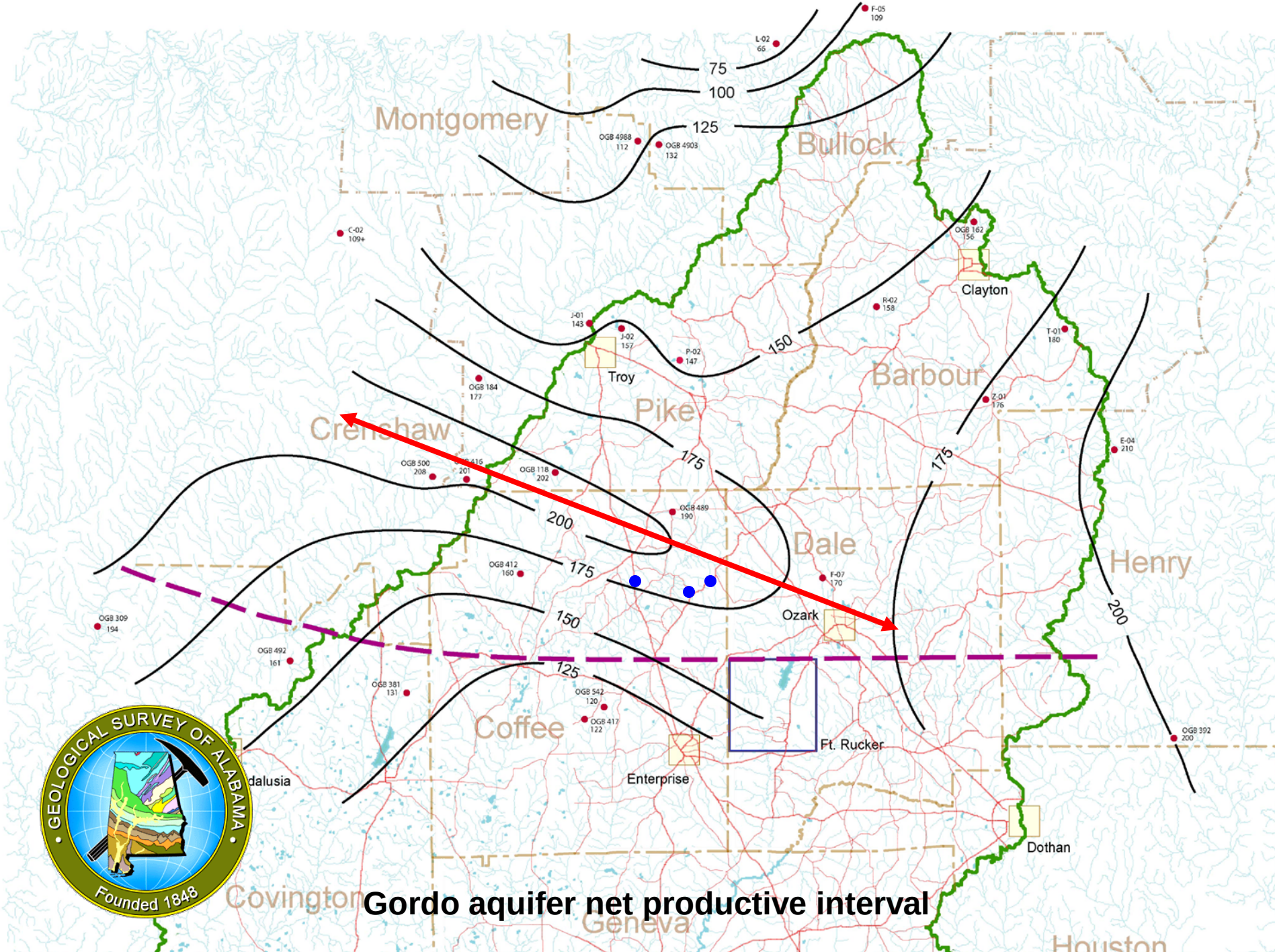



**Salt Mountain aquifer net productive interval**




**Clayton aquifer net productive interval**




**Gordo aquifer net productive interval**

## HYDROGEOLOGIC COMPONENTS

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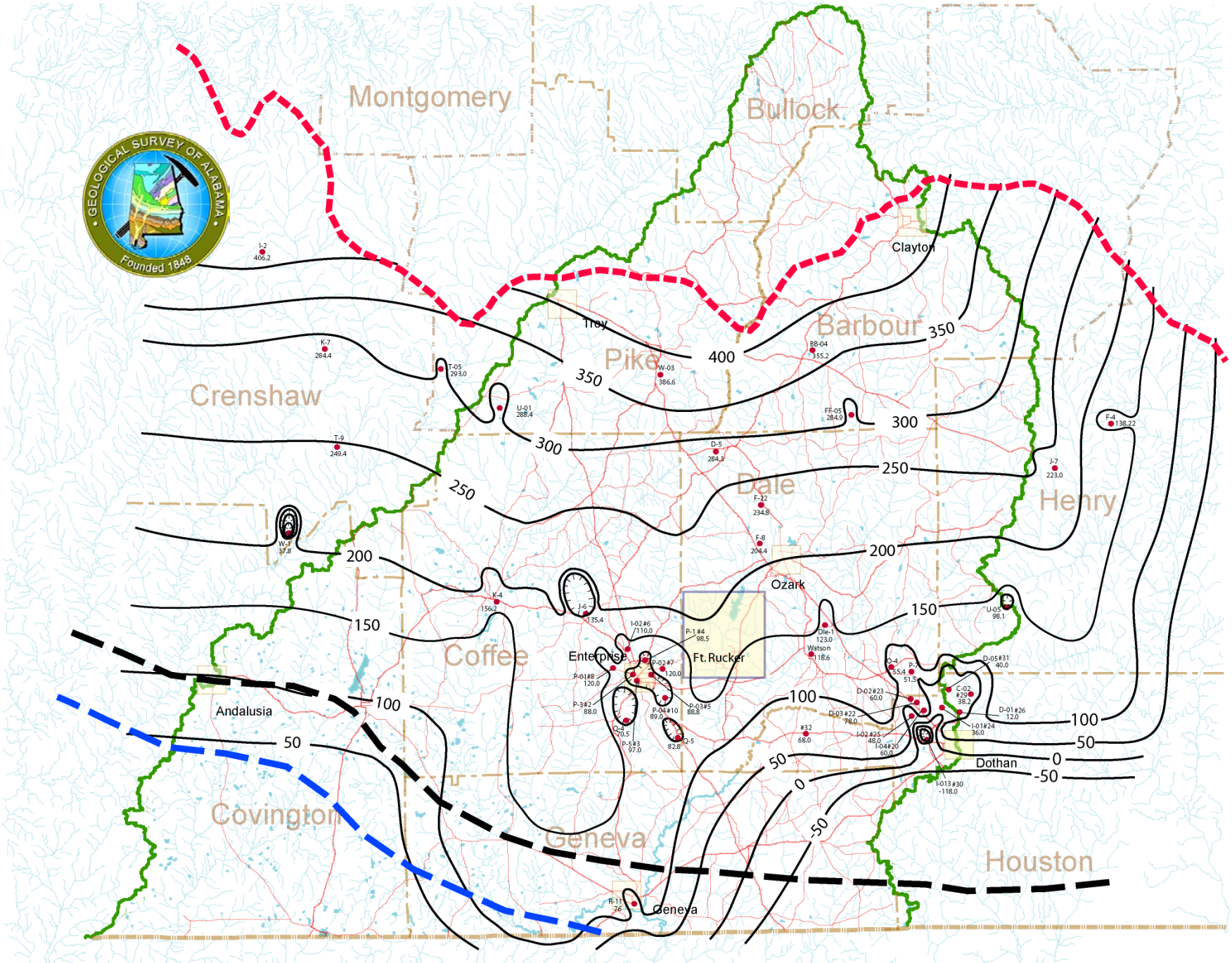
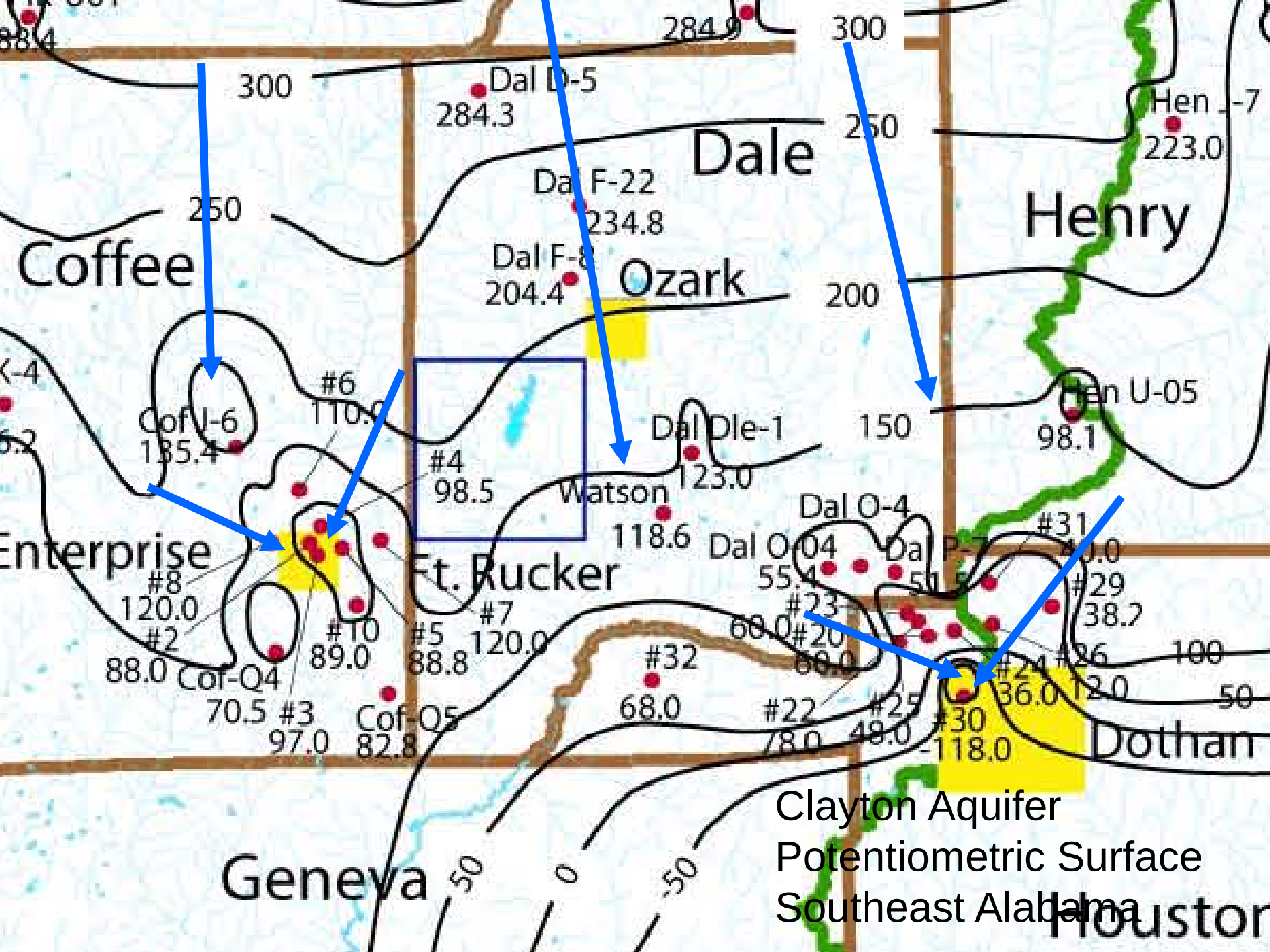
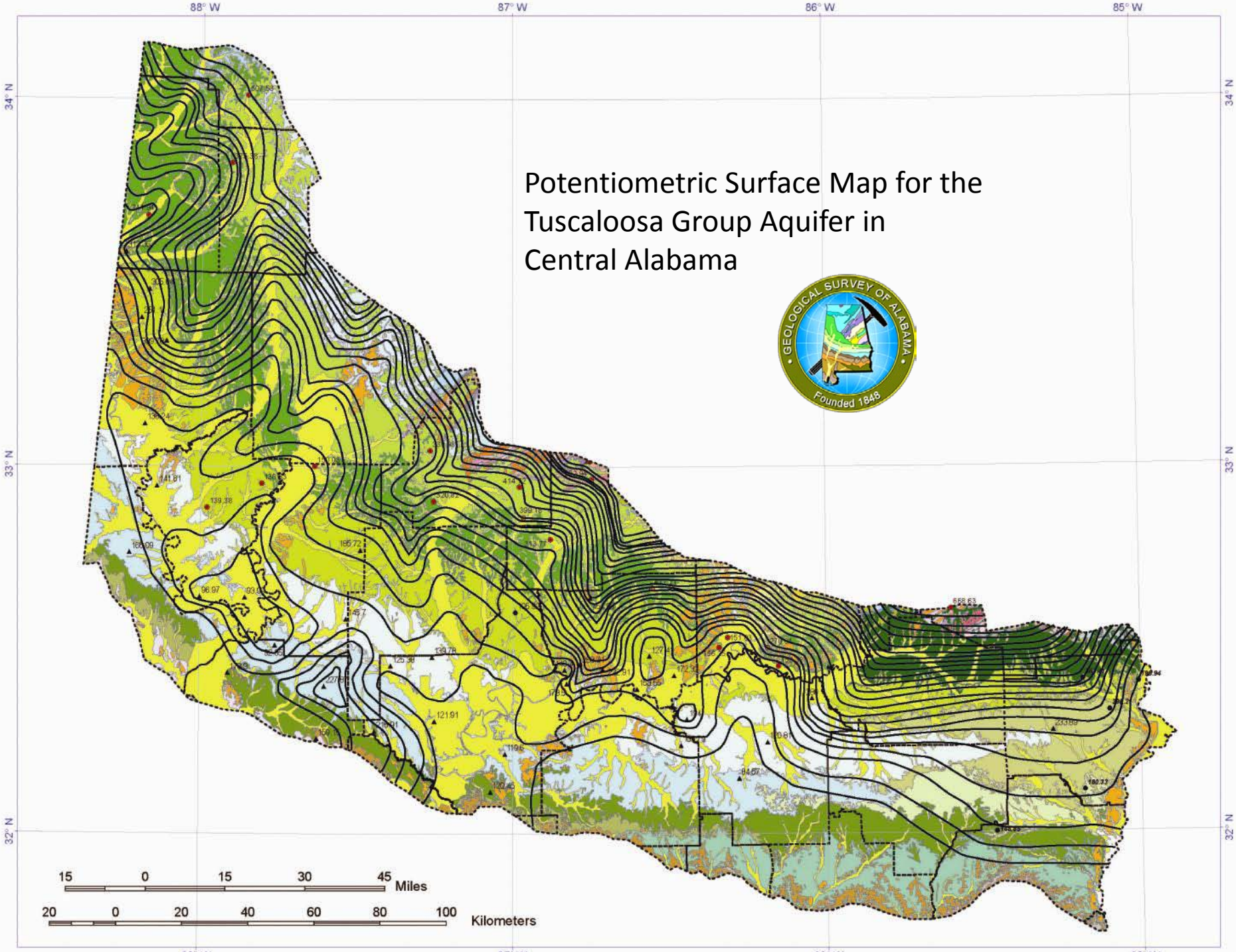
# Clayton Aquifer Potentiometric Surface






Clayton Aquifer
Potentiometric Surface
Southeast Alabama


Potentiometric Surface Map for the Tuscaloosa Group Aquifer in Central Alabama
GEOLOGICAL SURVEY OF ALABAMA
Founded 1848
88° W
87° W
86° W
85° W
34° N
33° N
32° N
15 0 15 30 45 Miles
20 0 20 40 60 80 100 Kilometers

**Explanation**

Geology

Quaternary

- Alluvial, coastal, and low terrace
- High terrace deposits

Tertiary

- Citronelle Formation
- Miocene Series undifferentiated

Other symbols

- Water body
- Baldwin and Mobile Counties groundwater irrigation assessment area
- Location and water level for wells with screens ranging between 47 and 220 feet below land surface
- Potentiometric contours (feet, datum mean sea level; contour interval 10 feet)
- County boundary
- City

BERRY H. (NICK) TEW, JR.
State Geologist

# GROUNDWATER POTENTIOMETRIC SURFACE OF AQUIFERS AT DEPTHS RANGING FROM 47 TO 220 FEET FOR THE BALDWIN AND MOBILE COUNTIES GROUNDWATER IRRIGATION ASSESMENT AREA

By
Dorina Murgulet
2010

# HYDROGEOLOGIC COMPONENTS

- **Well location maps** (water wells and oil and gas production and test wells will be sources of data for investigations).
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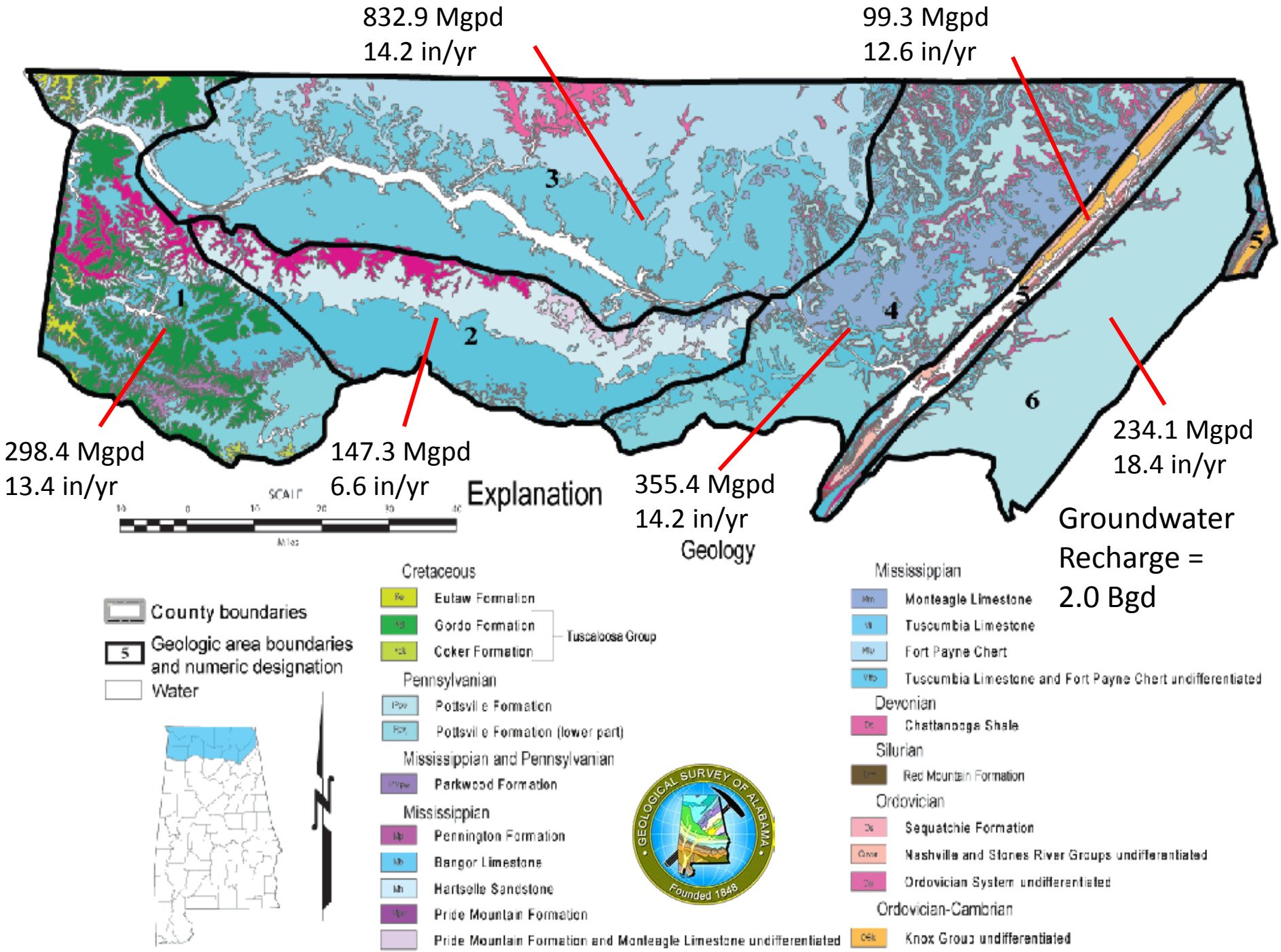
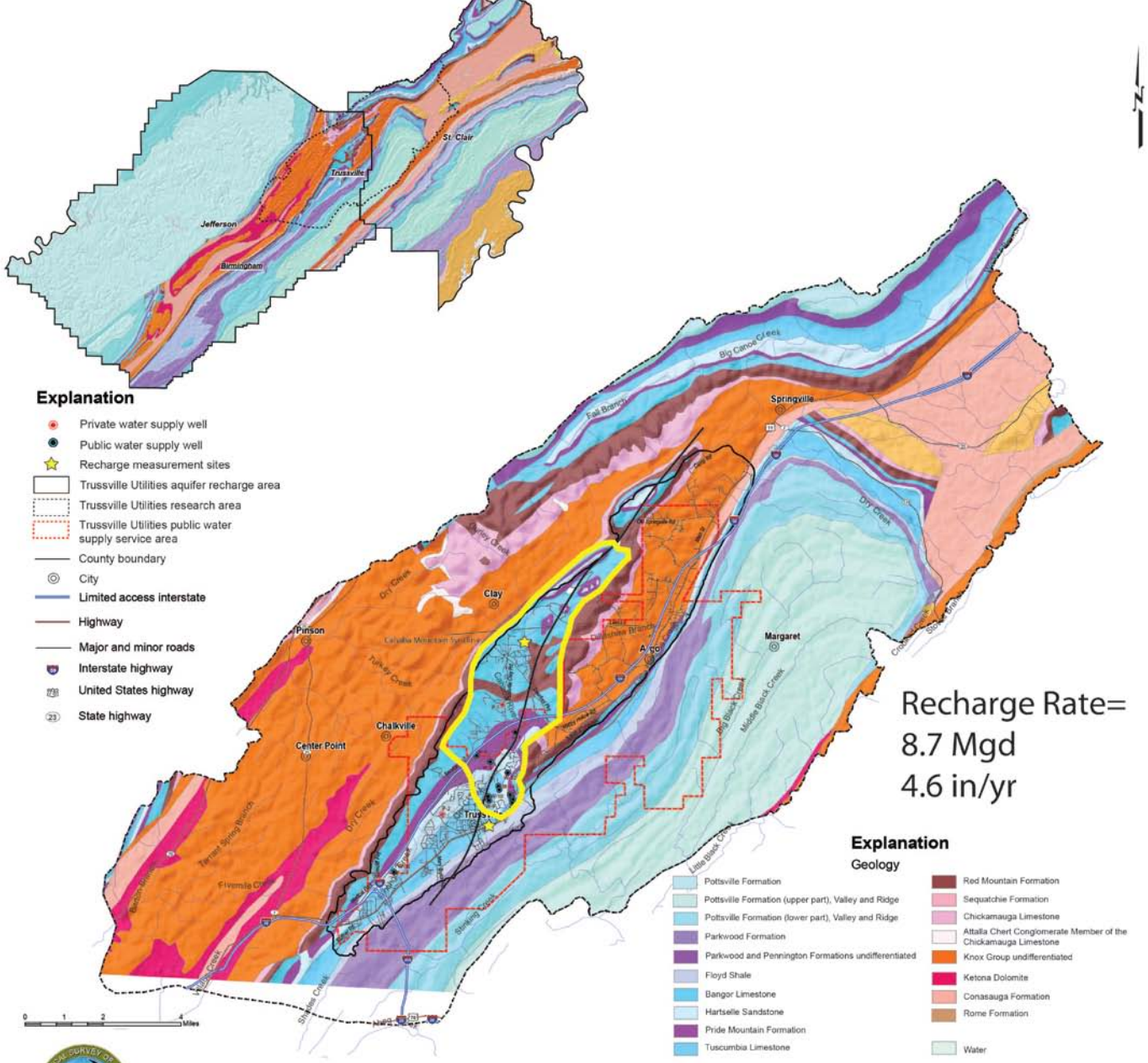

832.9 Mgpd
14.2 in/yr
99.3 Mgpd
12.6 in/yr
298.4 Mgpd
13.4 in/yr
147.3 Mgpd
6.6 in/yr
355.4 Mgpd
14.2 in/yr
234.1 Mgpd
18.4 in/yr
Groundwater Recharge = 2.0 Bgd
1
2
3
4
5
6
Explanation
Geology
County boundaries
Geologic area boundaries and numeric designation
Water
Cretaceous
Eutaw Formation
Gordo Formation
Coker Formation
Tuscaloosa Group
Pennsylvanian
Pottsville Formation
Pottsville Formation (lower part)
Mississippian and Pennsylvanian
Parkwood Formation
Mississippian
Pennington Formation
Bangor Limestone
Hartselle Sandstone
Pride Mountain Formation
Pride Mountain Formation and Monteagle Limestone undifferentiated
Mississippian
Monteagle Limestone
Tuscumbia Limestone
Fort Payne Chert
Tuscumbia Limestone and Fort Payne Chert undifferentiated
Devonian
Chattanooga Shale
Silurian
Red Mountain Formation
Ordovician
Sequatchie Formation
Nashville and Stones River Groups undifferentiated
Ordovician System undifferentiated
Ordovician-Cambrian
Knox Group undifferentiated
GEOLOGICAL SURVEY OF ALABAMA
Founded 1848




# TRUSSVILLE WELLS AND AQUIFER RECHARGE ASSESSMENT SITES

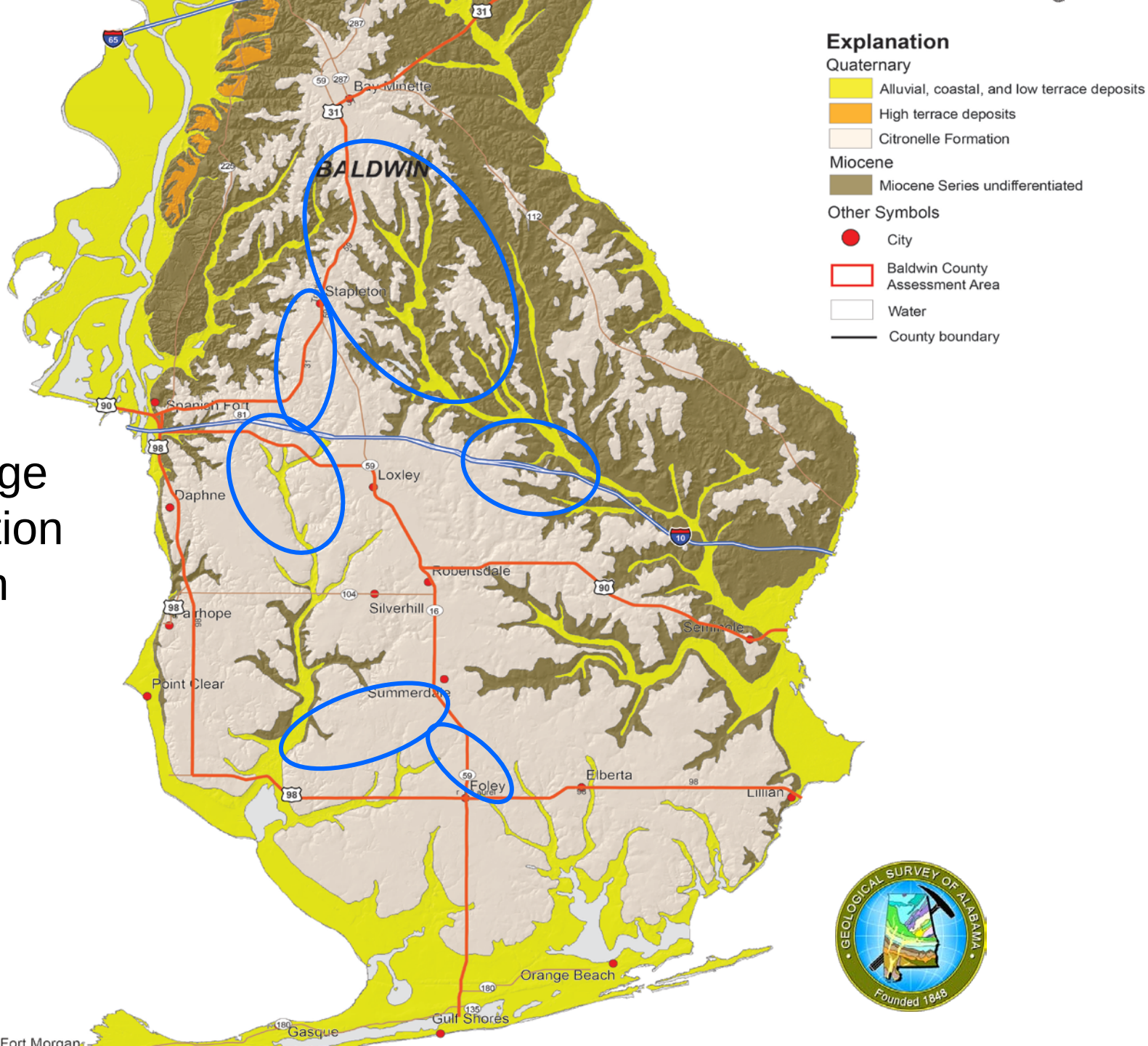
*(Geology from Szabo and Copeland, 1988)*

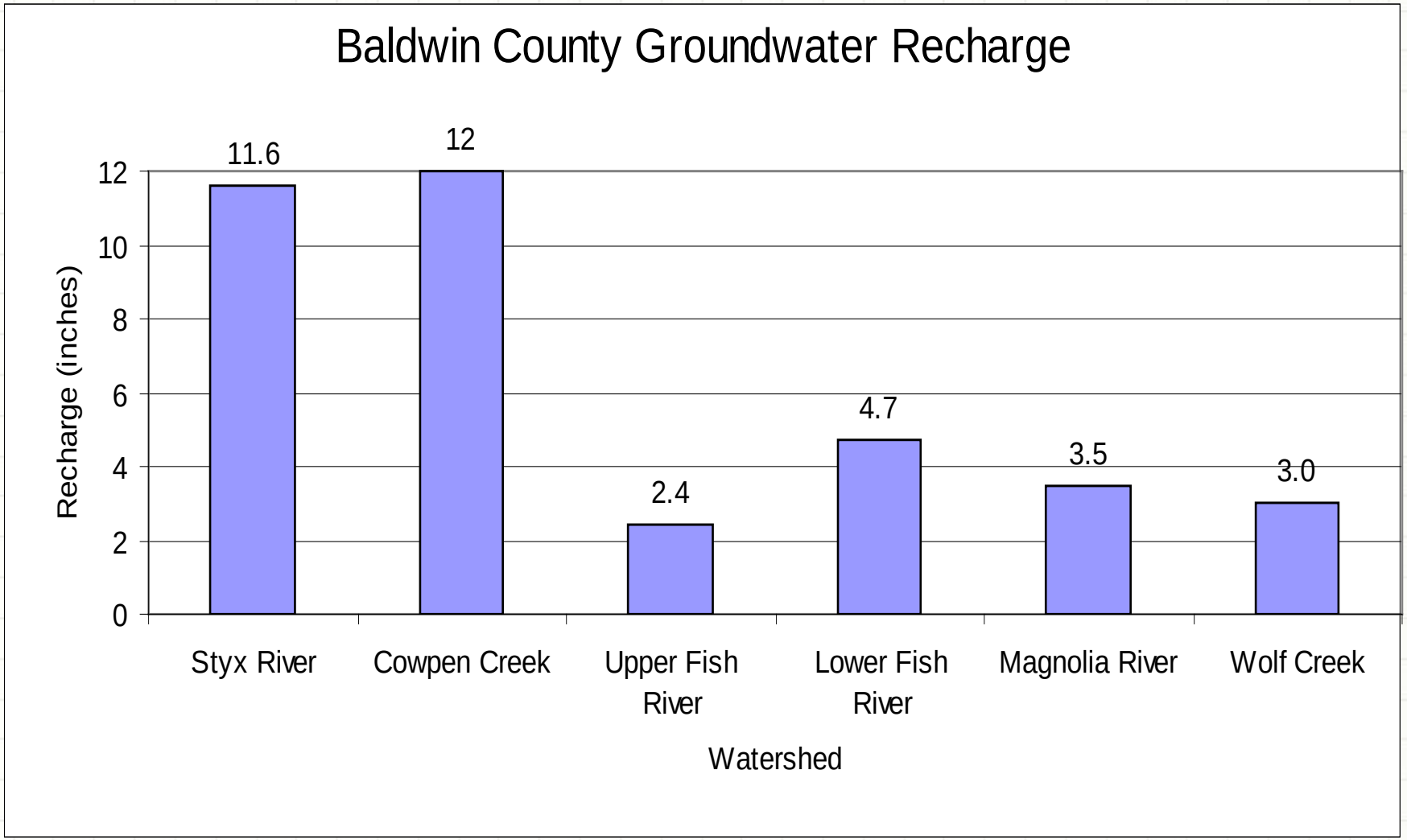

Berry H. (Nick) Tew, Jr.
State Geologist

By
Dorina Murgulet and Marlon Cook


2012

# Recharge Estimation Baldwin County




Baldwin County Groundwater Recharge
Recharge (inches)
0
2
4
6
8
10
12
11.6
12
2.4
4.7
3.5
3.0
Styx River
Cowpen Creek
Upper Fish River
Lower Fish River
Magnolia River
Wolf Creek
Watershed

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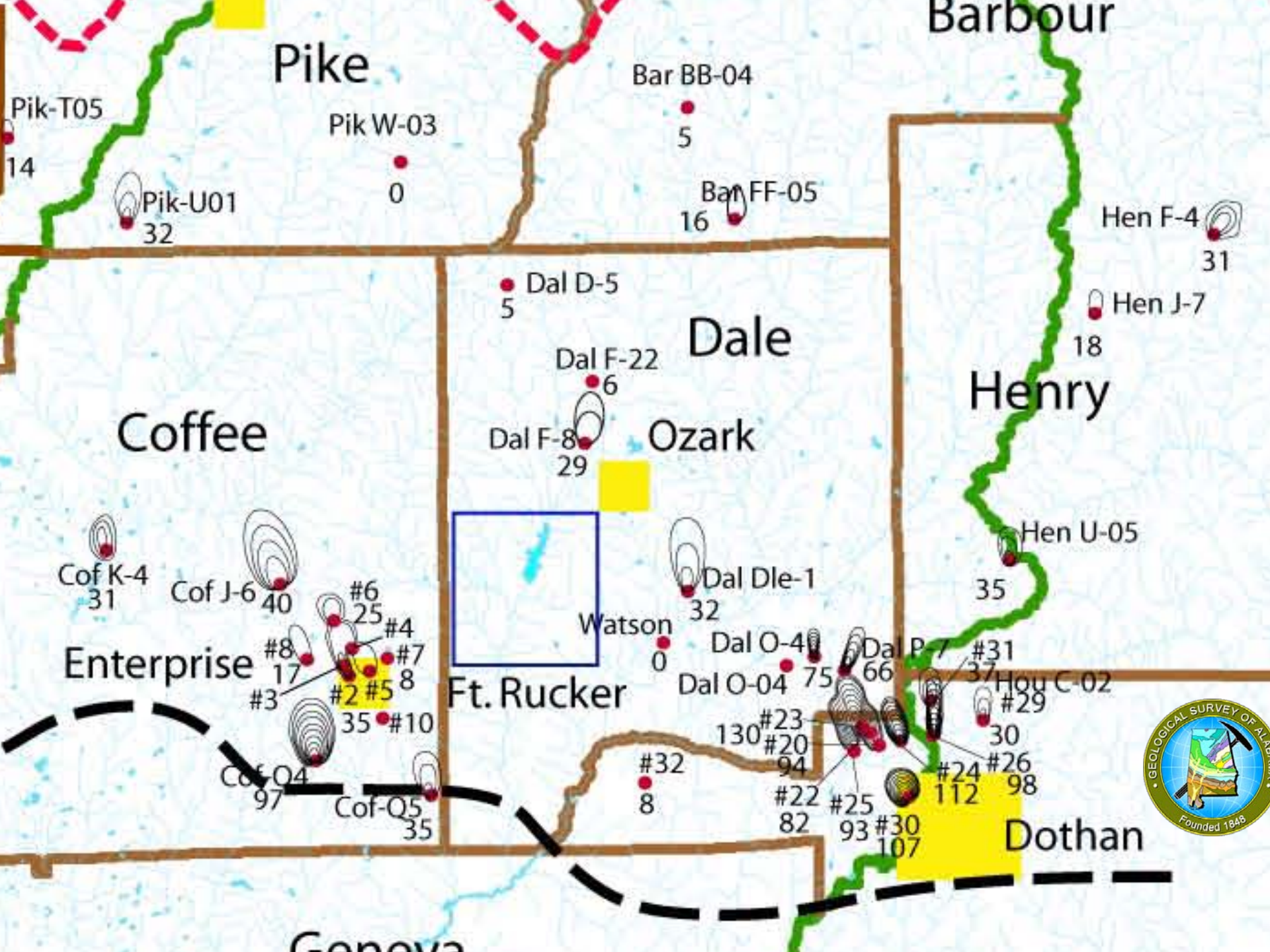
Barbour
Pike
Bar BB-04
5
Pik-T05
14
Pik W-03
0
Pik-U01
32
Bar FF-05
16
Hen F-4
31
Dal D-5
5
Hen J-7
18
Dale
Dal F-22
6
Henry
Coffee
Dal F-8
29
Ozark
Hen U-05
35
Cof K-4
31
Cof J-6
40
#6
25
#4
Dal Dle-1
32
Watson
0
#8
17
#7
8
Enterprise
#3
#2
#5
35
#10
Dal O-41
75
Dal O-04
Dal P-7
66
#31
37
Hou C-02
#29
30
Ft. Rucker
#23
130
#20
94
#26
98
#24
112
#32
8
#22
82
#25
93
#30
107
Cof-Q4
97
Cof-Q5
35
Dothan
Geneva

# Conservation Well Spacing

| Aquifer | Strike (miles) | Dip (miles) |
|---|---|---|
| Nanafalia | 1.0 | 2.0 |
| | | |
| Clayton | 1.0 | 2.0 |
| | | |
| Ripley/Cusseta | 1.0 | 2.5 |
| | | |
| Gordo | 1.5 | 2.0 |
| | | |

## GEOCHEMICAL COMPONENTS

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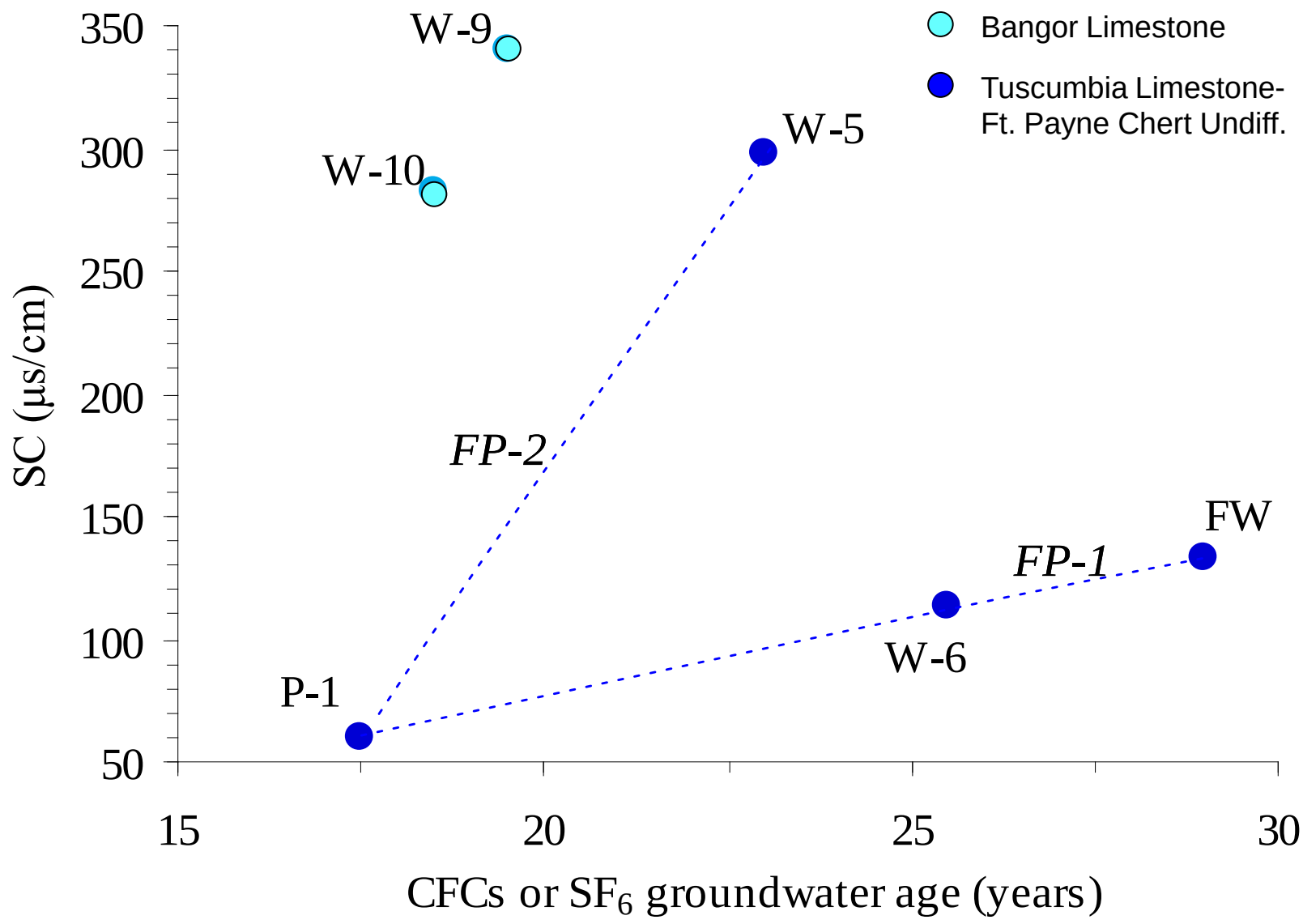
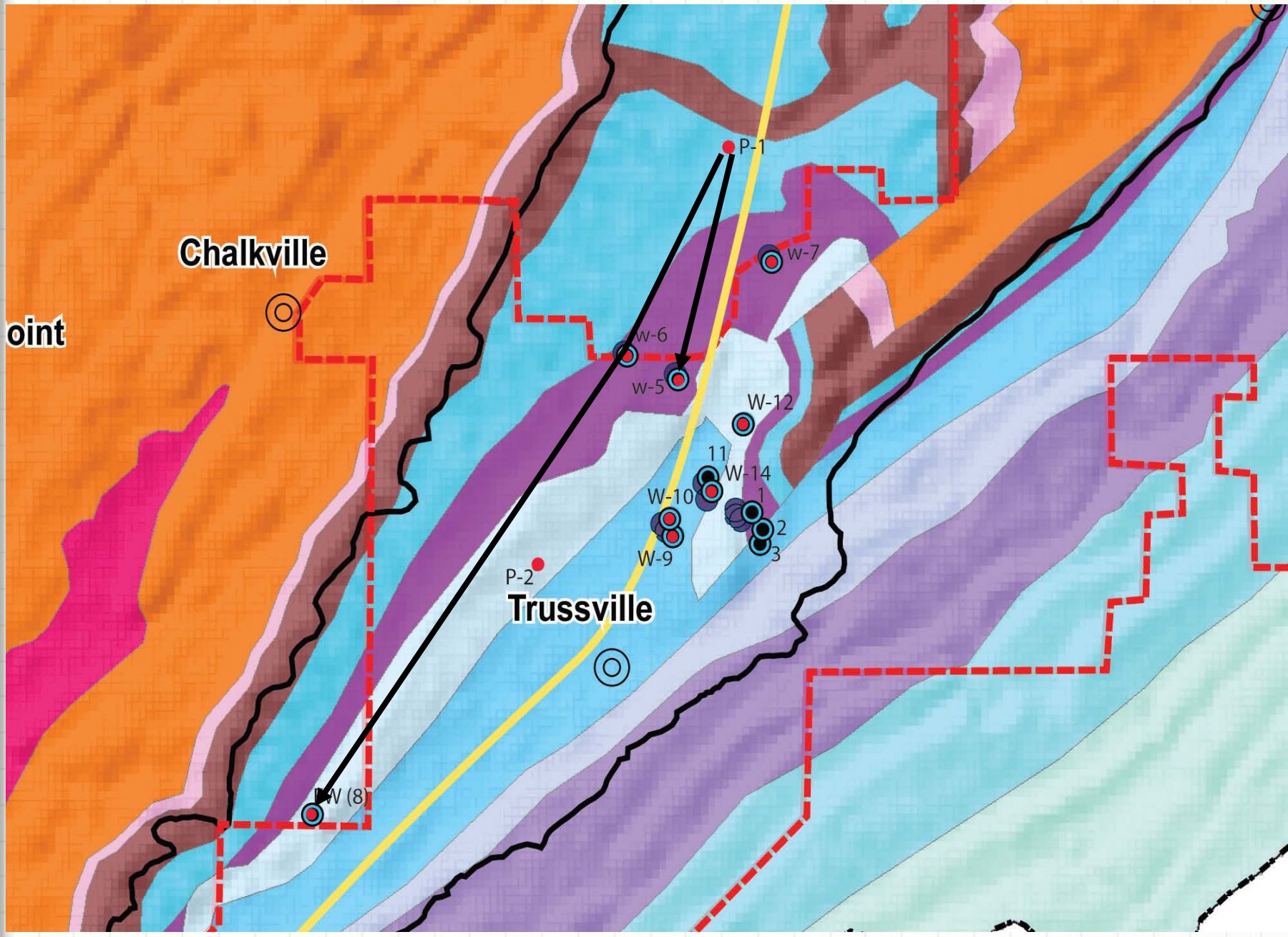
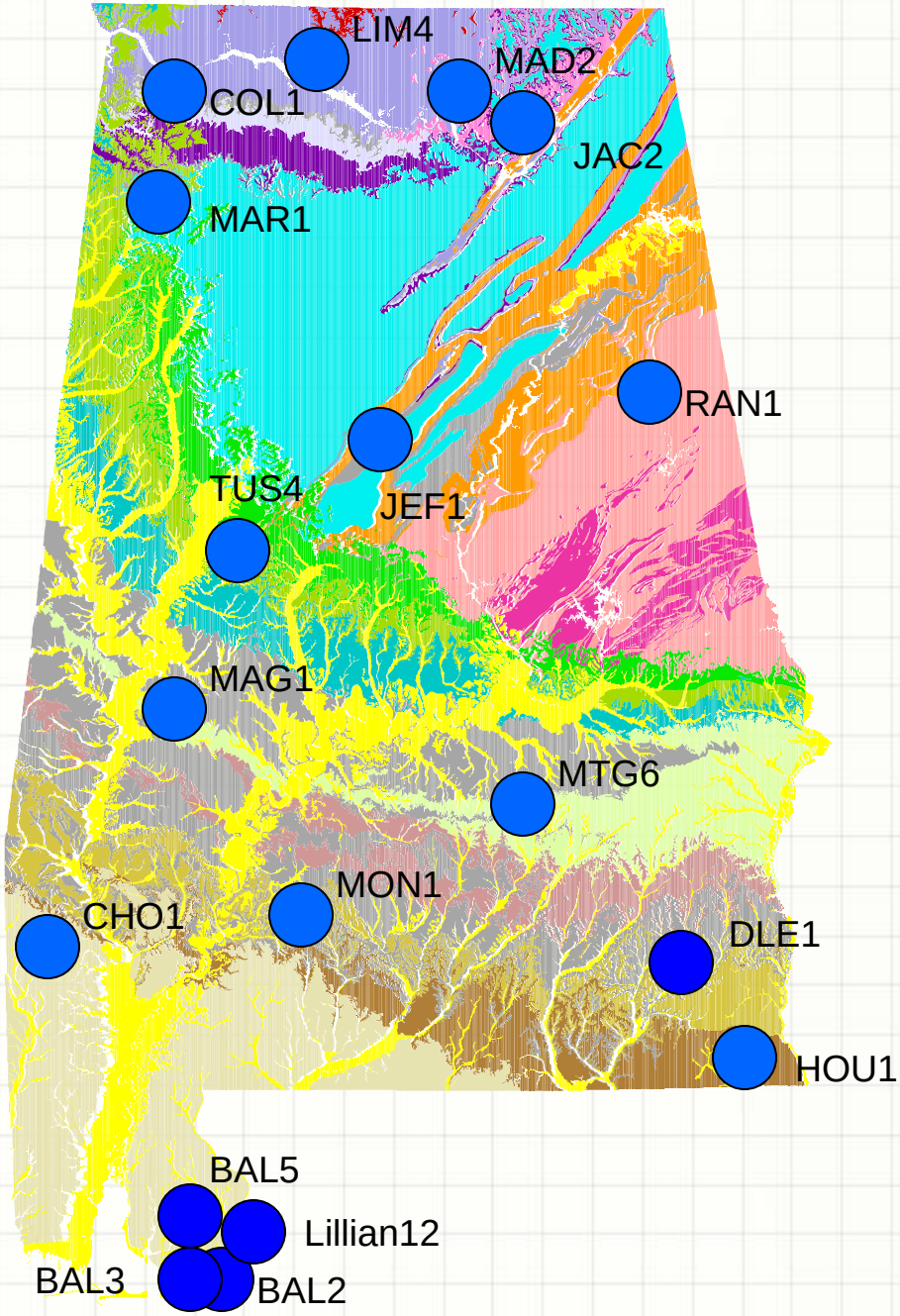
Artisian well near Eutaw
GSA Photo Archive

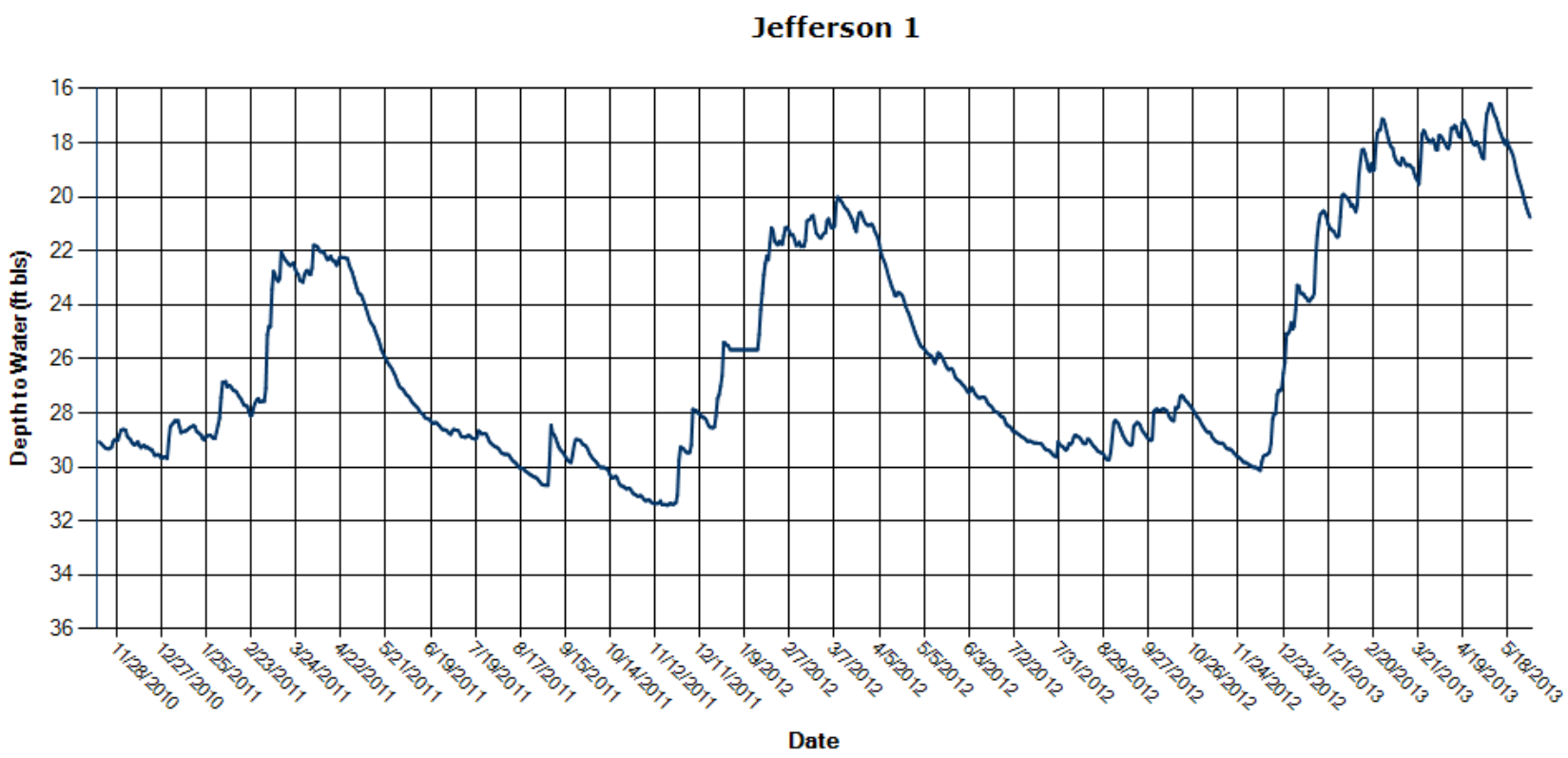
# Groundwater Flow Paths

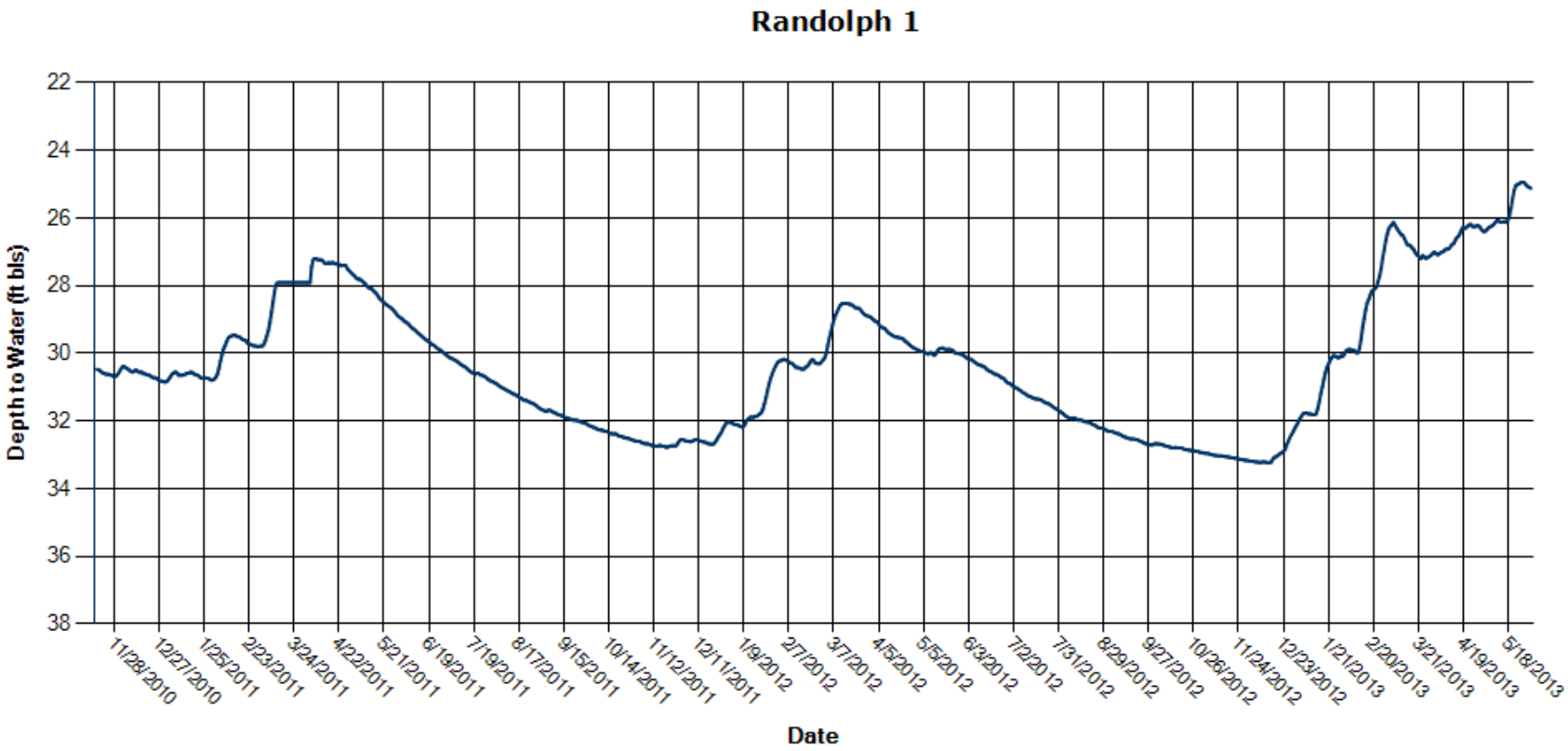


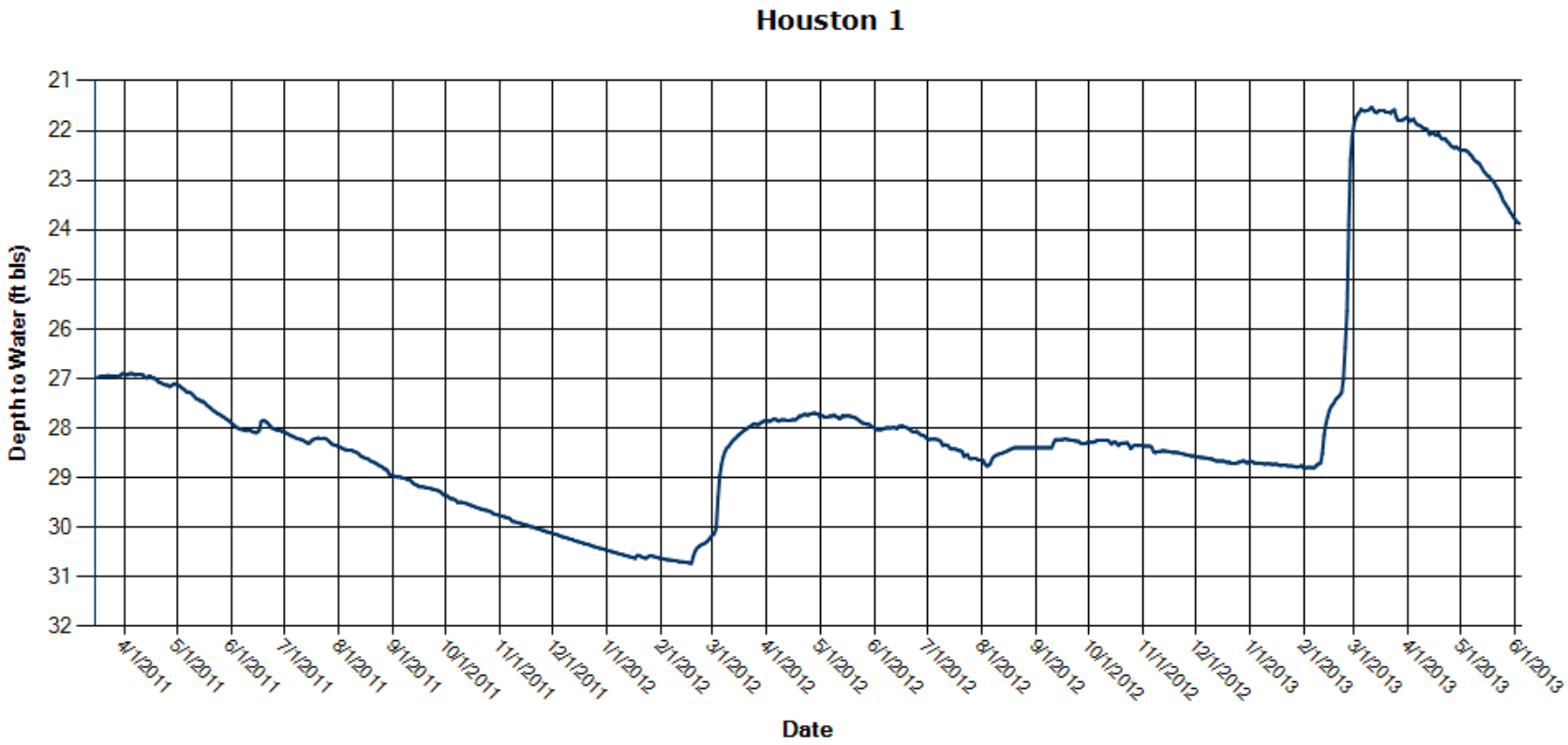

Chalkville
oint
P-1
w-7
w-6
w-5
W-12
11
W-14
W-10
1
2
3
W-9
P-2
Trussville
W (8)

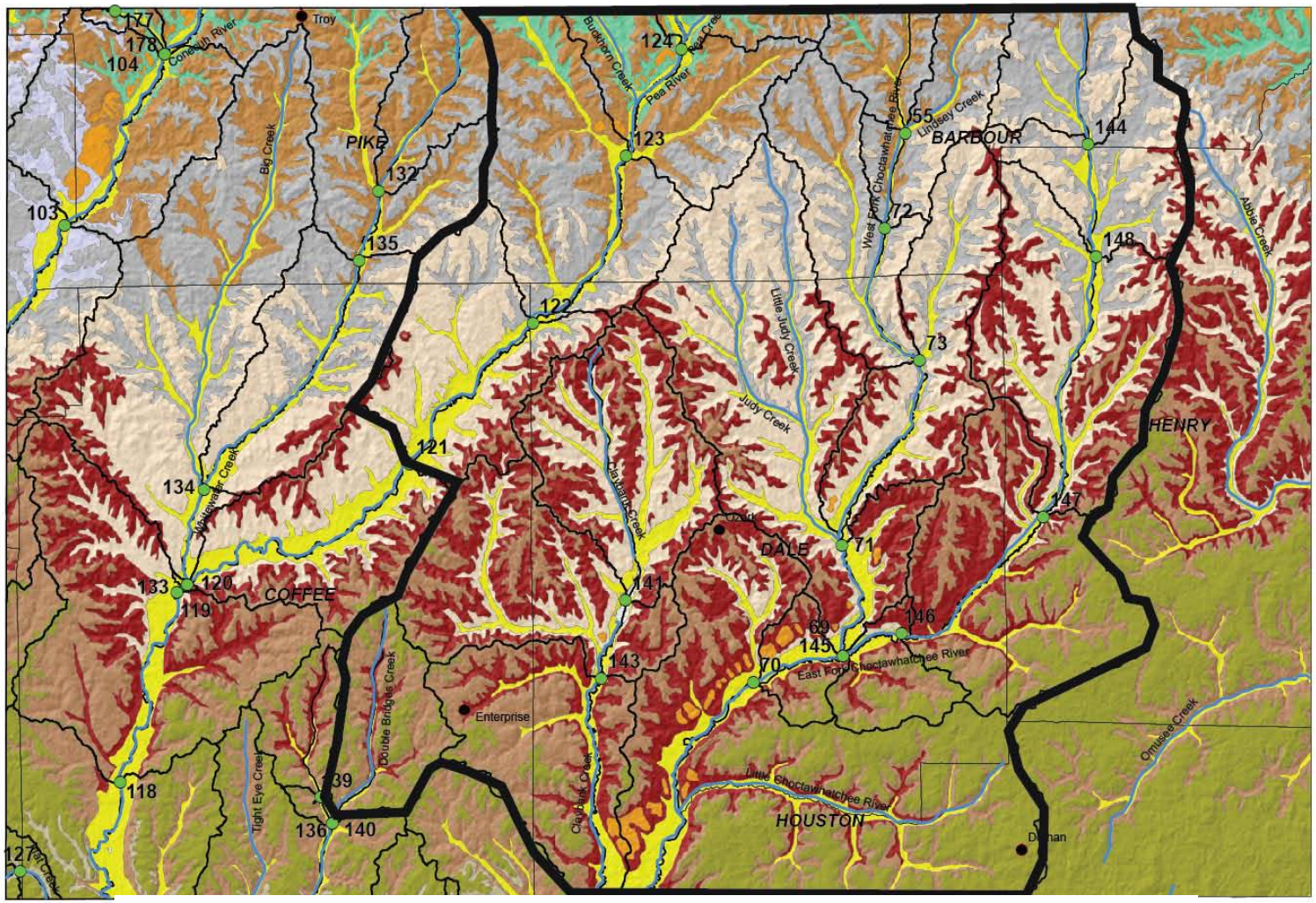
# Real Time Groundwater Level Monitoring

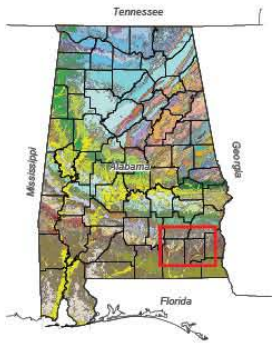



Jefferson 1
Depth to Water (ft bls)
16
18
20
22
24
26
28
30
32
34
36
11/28/2010
12/27/2010
1/25/2011
2/23/2011
3/24/2011
4/22/2011
5/21/2011
6/19/2011
7/19/2011
8/17/2011
9/15/2011
10/14/2011
11/12/2011
12/11/2011
1/9/2012
2/7/2012
3/7/2012
4/5/2012
5/5/2012
6/3/2012
7/2/2012
7/31/2012
8/29/2012
9/27/2012
10/26/2012
11/24/2012
12/23/2012
1/21/2013
2/20/2013
3/21/2013
4/19/2013
5/18/2013
Date


Randolph 1
Depth to Water (ft bls)
22
24
26
28
30
32
34
36
38
11/28/2010
12/27/2010
1/25/2011
2/23/2011
3/24/2011
4/22/2011
5/21/2011
6/19/2011
7/19/2011
8/17/2011
9/15/2011
10/14/2011
11/12/2011
12/11/2011
1/9/2012
2/7/2012
3/7/2012
4/5/2012
5/5/2012
6/3/2012
7/2/2012
7/31/2012
8/29/2012
9/27/2012
10/26/2012
11/24/2012
12/23/2012
1/21/2013
2/20/2013
3/21/2013
4/19/2013
5/18/2013
Date


Houston 1
Depth to Water (ft bls)
21
22
23
24
25
26
27
28
29
30
31
32
4/1/2011
5/1/2011
6/1/2011
7/1/2011
8/1/2011
9/1/2011
10/1/2011
11/1/2011
12/1/2011
1/1/2012
2/1/2012
3/1/2012
4/1/2012
5/1/2012
6/1/2012
7/1/2012
8/1/2012
9/1/2012
10/1/2012
11/1/2012
12/1/2012
1/1/2013
2/1/2013
3/1/2013
4/1/2013
5/1/2013
6/1/2013
Date




**Explanation**

Quaternary
- Alluvial, coastal, and low terrace
- High terrace deposits
- Citronelle Formation

Tertiary
- Miocene Series undifferentiated

Oligocene
- Oligocene Series undifferentiated

Eocene-Oligocene
- Residuum

Eocene
- Jackson Group undifferentiated
- Lisbon Formation
- Tallahatta Formation
- Hatchetigbee Formation

Paleocene
- Tuscahoma Sand
- Nanafalia Formation
- Naheola Formation
- Porters Creek Formation
- Clayton Formation

Cretaceous
- Prairie Bluff Chalk
- Providence Sand
- Ripley Formation
- Demopolis Chalk
- Cusseta Sand Member
- Blufftown Formation

Other Symbols
- Rivers and Streams
- County boundary
- Southeast Alabama Study Area
- Monitored Subwatersheds
- 146 Gage Identification
- Cities

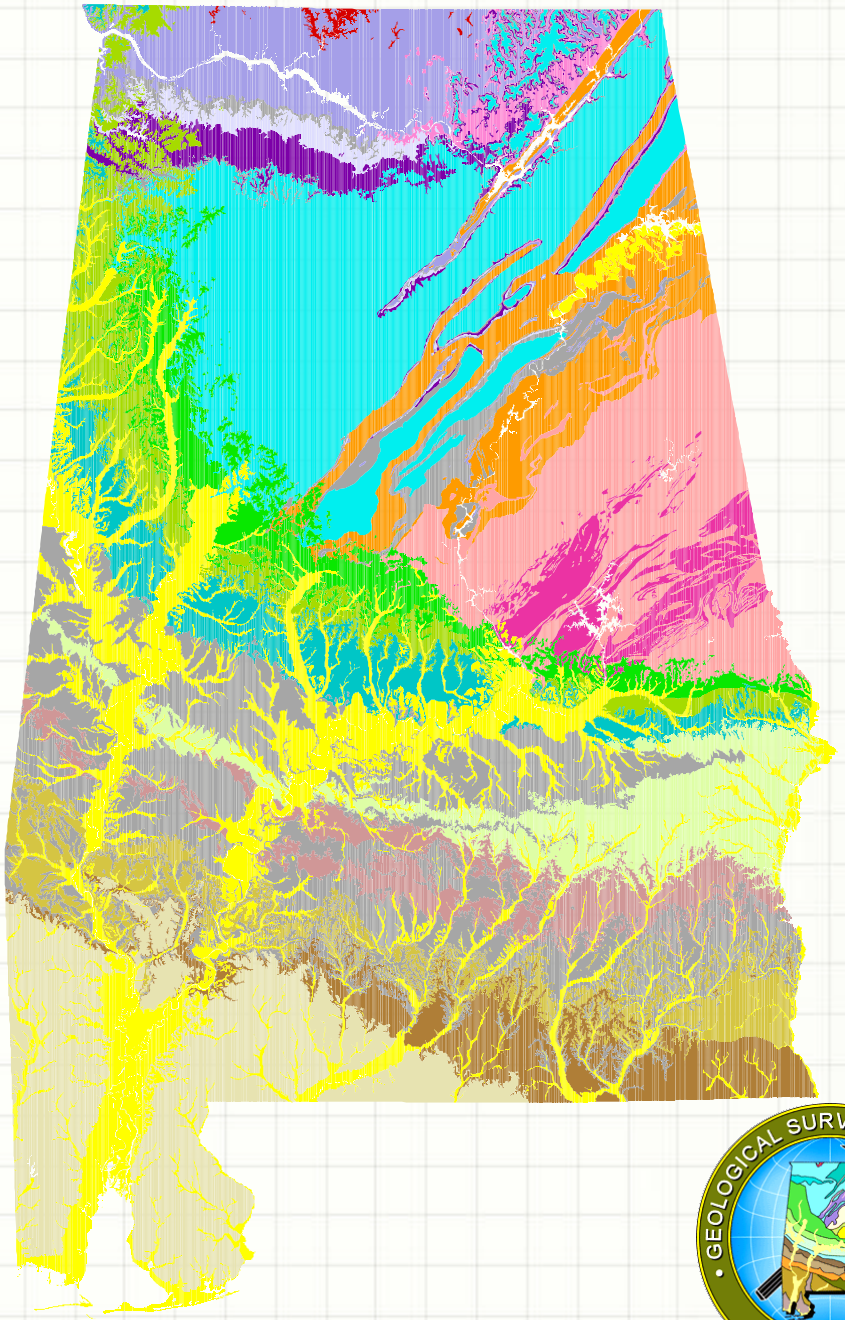
# Southeast Alabama Water Resource Assessment

***GEOLOGIC MAP AND ESTIMATED DISCHARGE FOR SELECTED SUBWATERSHEDS FOR THE SOUTHEASTERN ALABAMA ASSESSMENT AREA***

0 3 6 12 18 24 Miles

Berry H. (Nick) Tew, Jr.
State Geologist

# Statewide Groundwater Assessment



# Questions?