Aquifer Science and Groundwater Management of the Edwards and Trinity Aquifers in Central Texas

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Presentation to City of Sunset Valley
March 7, 2017

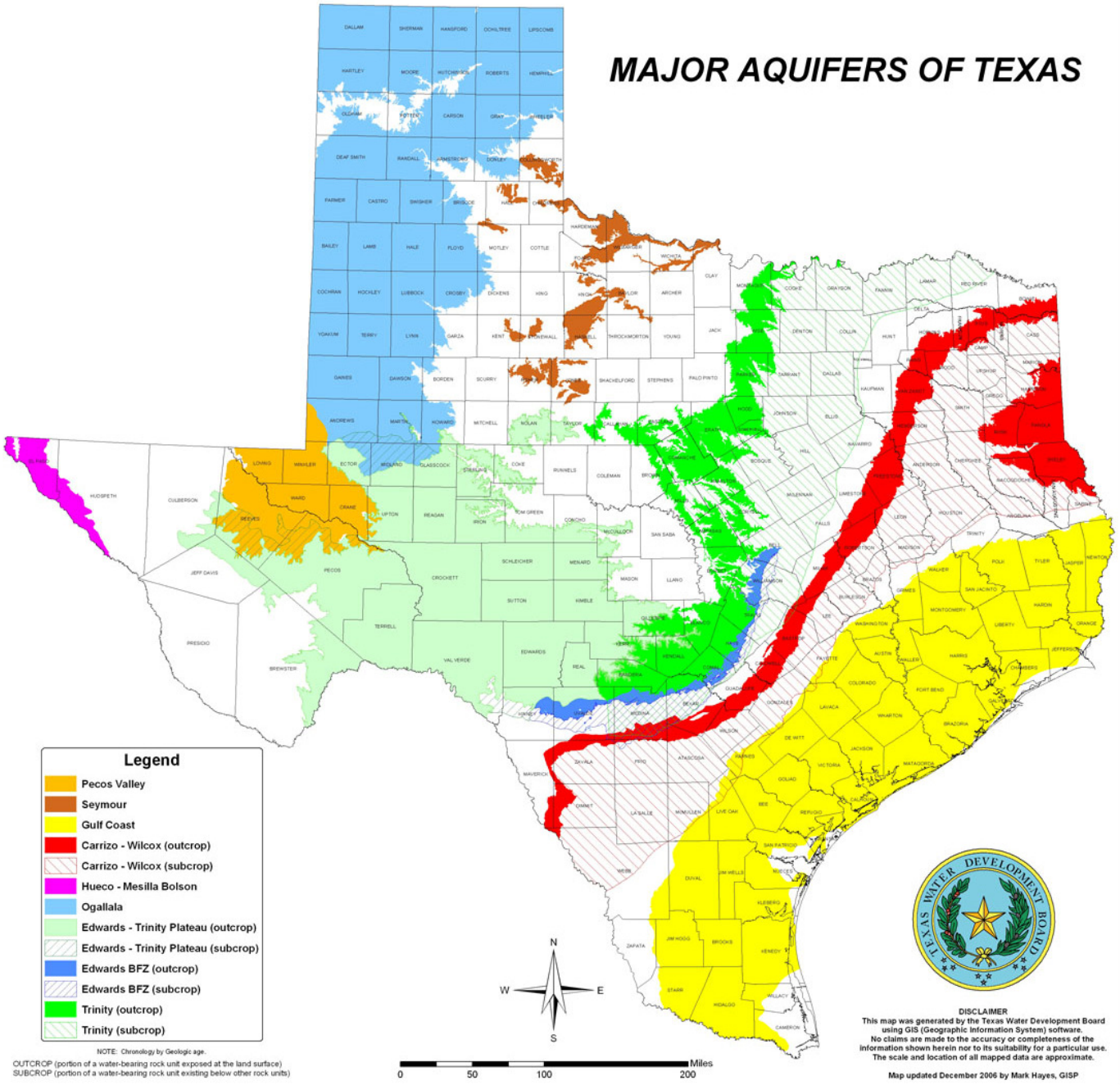
Barton Springs/Edwards Aquifer
Conservation District

What is the Barton Springs/Edwards Aquifer Conservation District?

- A long name for a very small agency.
- One of one hundred groundwater conservation districts in Texas.
- The district responsible for groundwater management south of the Colorado River and north of San Marcos Springs.
- Not the Edwards Aquifer Authority.

Barton Springs
Edwards Aquifer
Conservation District

MAJOR AQUIFERS OF TEXAS

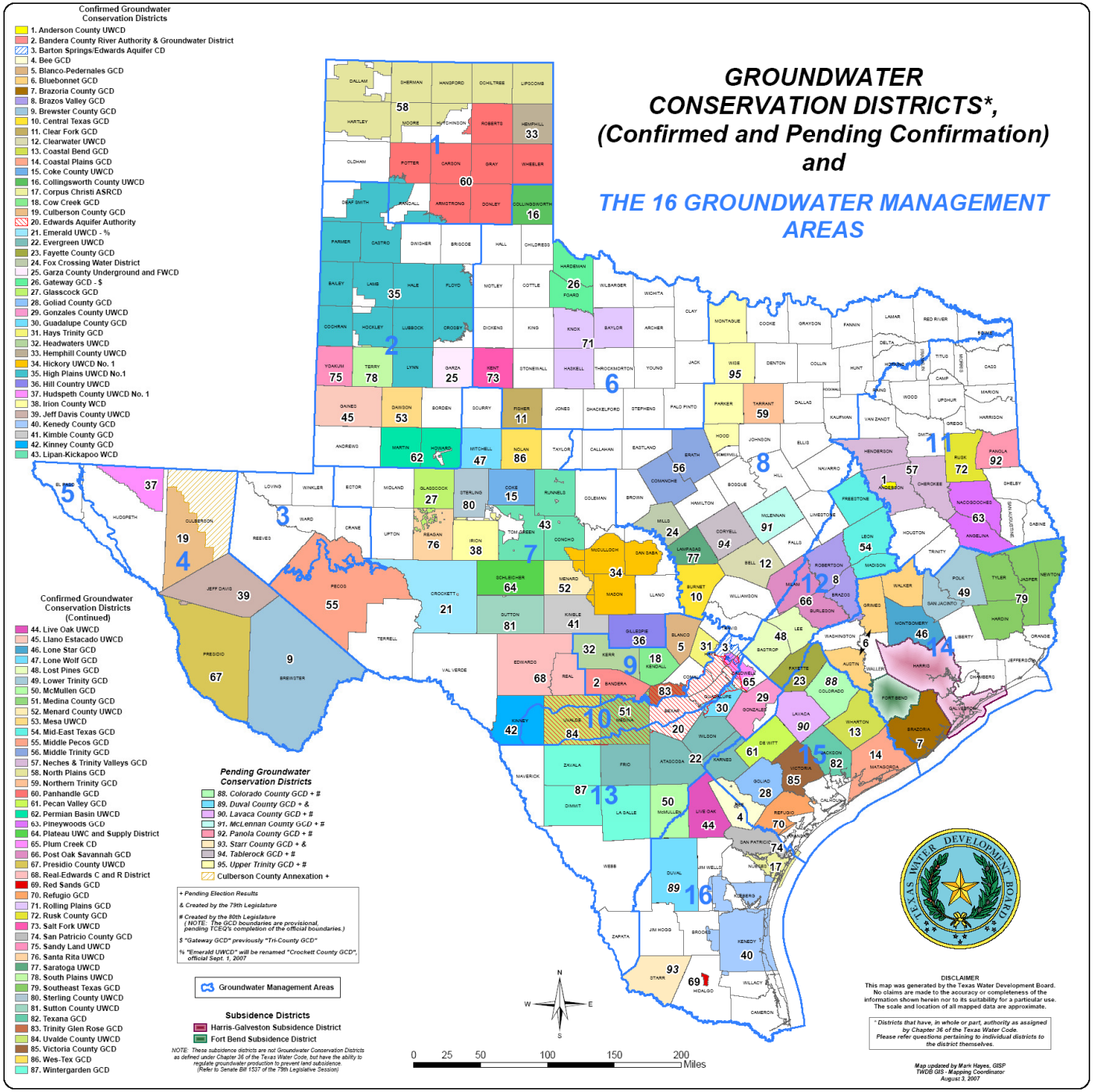


NOTE: Chronology by Geologic age.

OUTCROP (portion of a water-bearing rock unit exposed at the land surface)
SUBCROP (portion of a water-bearing rock unit existing below other rock units)

DISCLAIMER
This map was generated by the Texas Water Development Board using GIS (Geographic Information System) software. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate.

Map updated December 2006 by Mark Hayes, GISP


GROUNDWATER CONSERVATION DISTRICTS*, (Confirmed and Pending Confirmation) and
THE 16 GROUNDWATER MANAGEMENT AREAS
Confirmed Groundwater Conservation Districts
1. Anderson County UWCD
2. Bandera County River Authority & Groundwater District
3. Barton Springs/Edwards Aquifer CD
4. Bee GCD
5. Blanco-Pedernales GCD
6. Bluebonnet GCD
7. Brazoria County GCD
8. Brazos Valley GCD
9. Brewster County GCD
10. Central Texas GCD
11. Clear Fork GCD
12. Clearwater UWCD
13. Coastal Bend GCD
14. Coastal Plains GCD
15. Coke County UWCD
16. Collingsworth County UWCD
17. Corpus Christi ASRCD
18. Cow Creek GCD
19. Culberson County GCD
20. Edwards Aquifer Authority
21. Emerald UWCD - %
22. Evergreen UWCD
23. Fayette County GCD
24. Fox Crossing Water District
25. Garza County Underground and FWCD
26. Gateway GCD - $
27. Glasscock GCD
28. Goliad County GCD
29. Gonzales County UWCD
30. Guadalupe County GCD
31. Hays Trinity GCD
32. Headwaters UWCD
33. Hemphill County UWCD
34. Hickory UWCD No. 1
35. High Plains UWCD No.1
36. Hill Country UWCD
37. Hudspeth County UWCD No. 1
38. Irion County WCD
39. Jeff Davis County UWCD
40. Kenedy County GCD
41. Kimble County GCD
42. Kinney County GCD
43. Lipan-Kickapoo WCD
Confirmed Groundwater Conservation Districts (Continued)
44. Live Oak UWCD
45. Llano Estacado UWCD
46. Lone Star GCD
47. Lone Wolf GCD
48. Lost Pines GCD
49. Lower Trinity GCD
50. McMullen GCD
51. Medina County GCD
52. Menard County UWCD
53. Mesa UWCD
54. Mid-East Texas GCD
55. Middle Pecos GCD
56. Middle Trinity GCD
57. Neches & Trinity Valleys GCD
58. North Plains GCD
59. Northern Trinity GCD
60. Panhandle GCD
61. Pecan Valley GCD
62. Permian Basin UWCD
63. Pineywoods GCD
64. Plateau UWC and Supply District
65. Plum Creek CD
66. Post Oak Savannah GCD
67. Presidio County UWCD
68. Real-Edwards C and R District
69. Red Sands GCD
70. Refugio GCD
71. Rolling Plains GCD
72. Rusk County GCD
73. Salt Fork UWCD
74. San Patricio County GCD
75. Sandy Land UWCD
76. Santa Rita UWCD
77. Saratoga UWCD
78. South Plains UWCD
79. Southeast Texas GCD
80. Sterling County UWCD
81. Sutton County UWCD
82. Texana GCD
83. Trinity Glen Rose GCD
84. Uvalde County UWCD
85. Victoria County GCD
86. Wes-Tex GCD
87. Wintergarden GCD
Pending Groundwater Conservation Districts
88. Colorado County GCD + #
89. Duval County GCD + &
90. Lavaca County GCD + #
91. McLennan County GCD + #
92. Panola County GCD + #
93. Starr County GCD + &
94. Tablerock GCD + #
95. Upper Trinity GCD + #
Culberson County Annexation +
+ Pending Election Results
& Created by the 79th Legislature
# Created by the 80th Legislature (NOTE: The GCD boundaries are provisional, pending TCEQ's completion of the official boundaries.)
$ "Gateway GCD" previously "Tri-County GCD"
% "Emerald UWCD" will be renamed "Crockett County GCD", official Sept. 1, 2007
Groundwater Management Areas
Subsidence Districts
Harris-Galveston Subsidence District
Fort Bend Subsidence District
NOTE: These subsidence districts are not Groundwater Conservation Districts as defined under Chapter 36 of the Texas Water Code, but have the ability to regulate groundwater production to prevent land subsidence. (Refer to Senate Bill 1537 of the 79th Legislative Session)
N
W
E
S
0 25 50 100 150 200 Miles
TEXAS WATER DEVELOPMENT BOARD
DISCLAIMER
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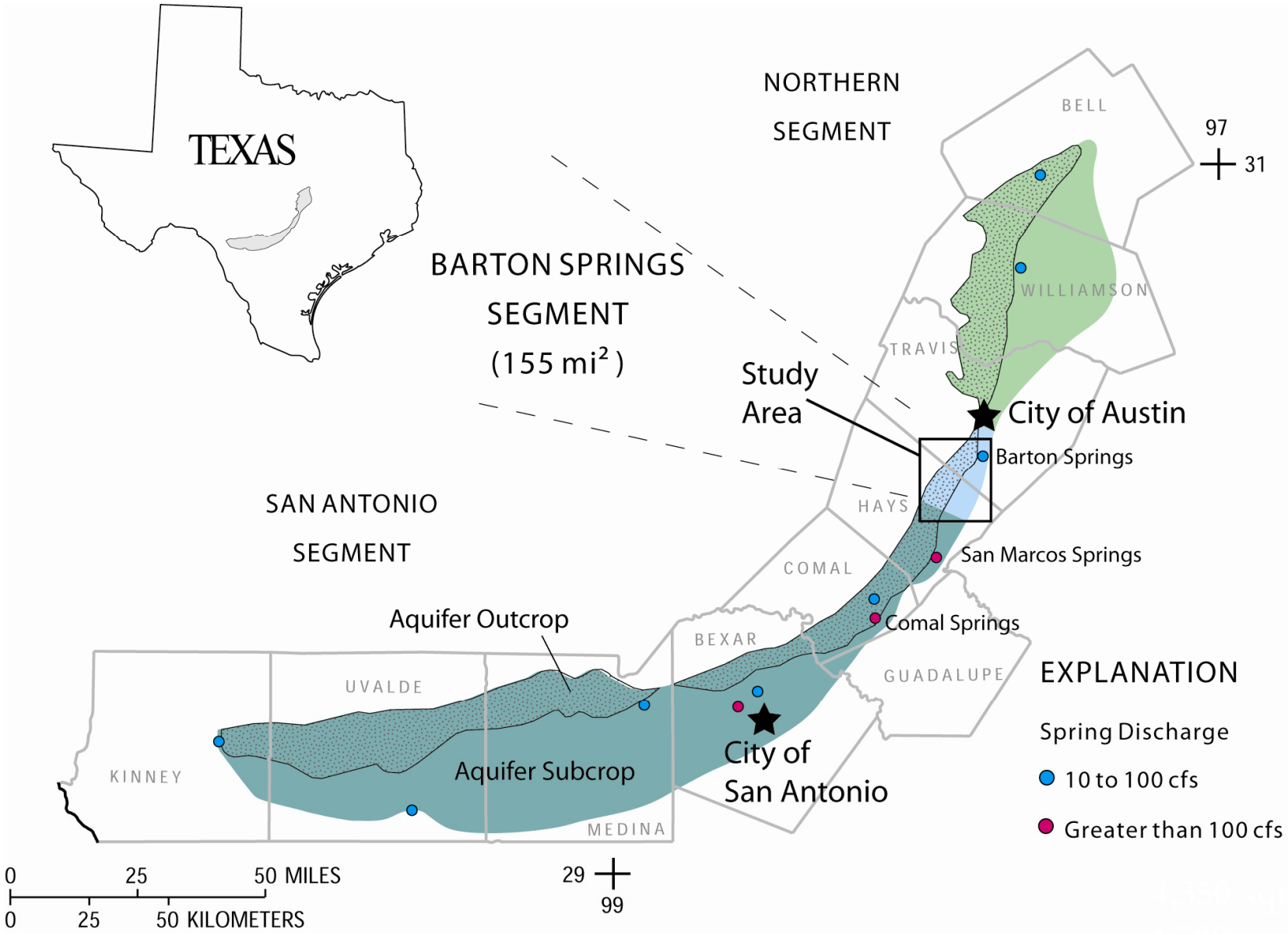
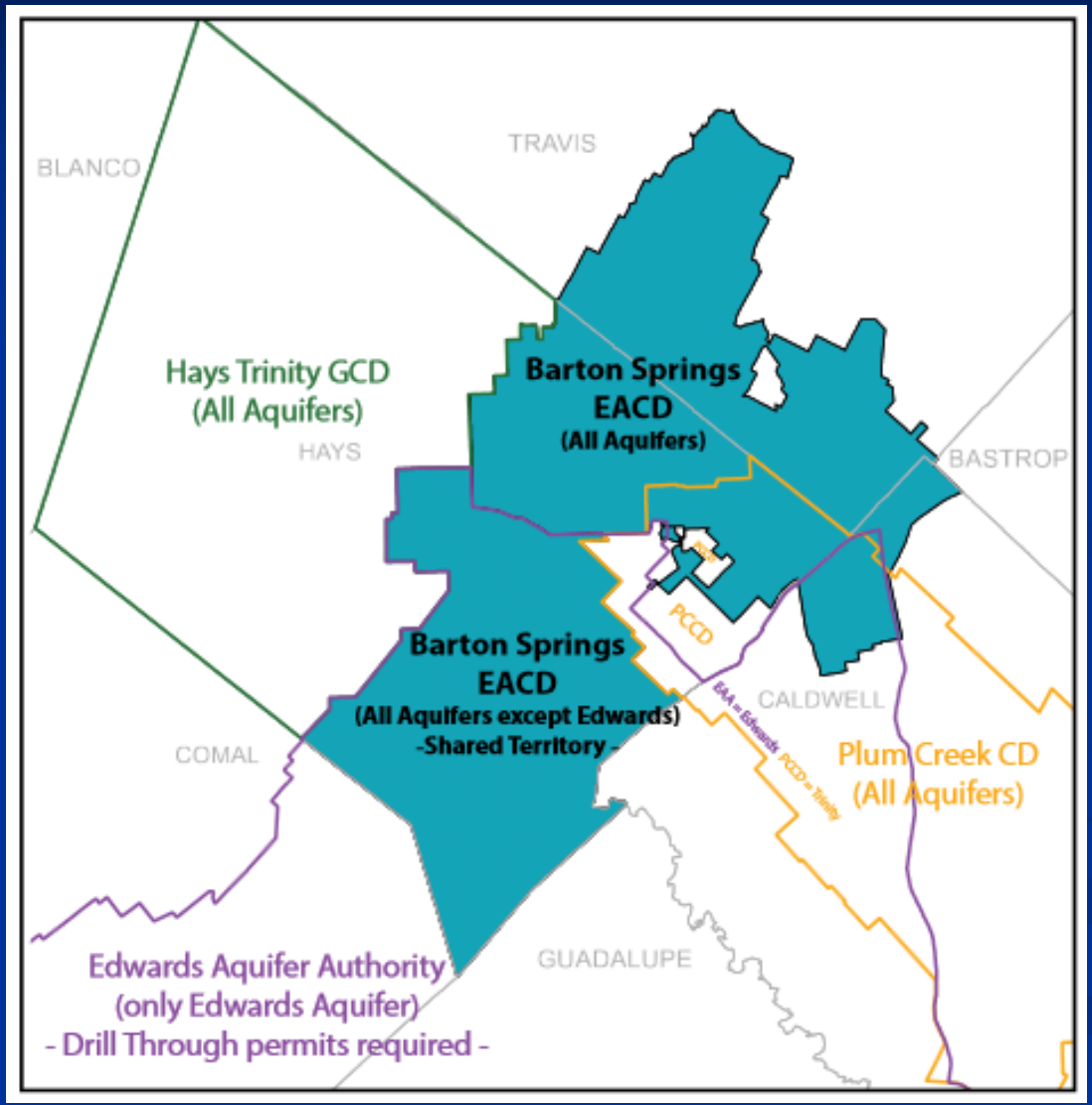
* Districts that have, in whole or part, authority as assigned by Chapter 36 of the Texas Water Code. Please refer questions pertaining to individual districts to the district themselves.
Map updated by Mark Hayes, GISP
TWDB GIS - Mapping Coordinator
August 3, 2007

Location


TEXAS
NORTHERN
SEGMENT
BARTON SPRINGS
SEGMENT
(155 mi²)
SAN ANTONIO
SEGMENT
Study
Area
City of Austin
Barton Springs
San Marcos Springs
Comal Springs
Aquifer Outcrop
Aquifer Subcrop
City of
San Antonio
BELL
WILLIAMSON
TRAVIS
HAYS
COMAL
BEXAR
GUADALUPE
UVALDE
KINNEY
MEDINA
97
31
29
99
0 25 50 MILES
0 25 50 KILOMETERS
EXPLANATION
Spring Discharge
10 to 100 cfs
Greater than 100 cfs

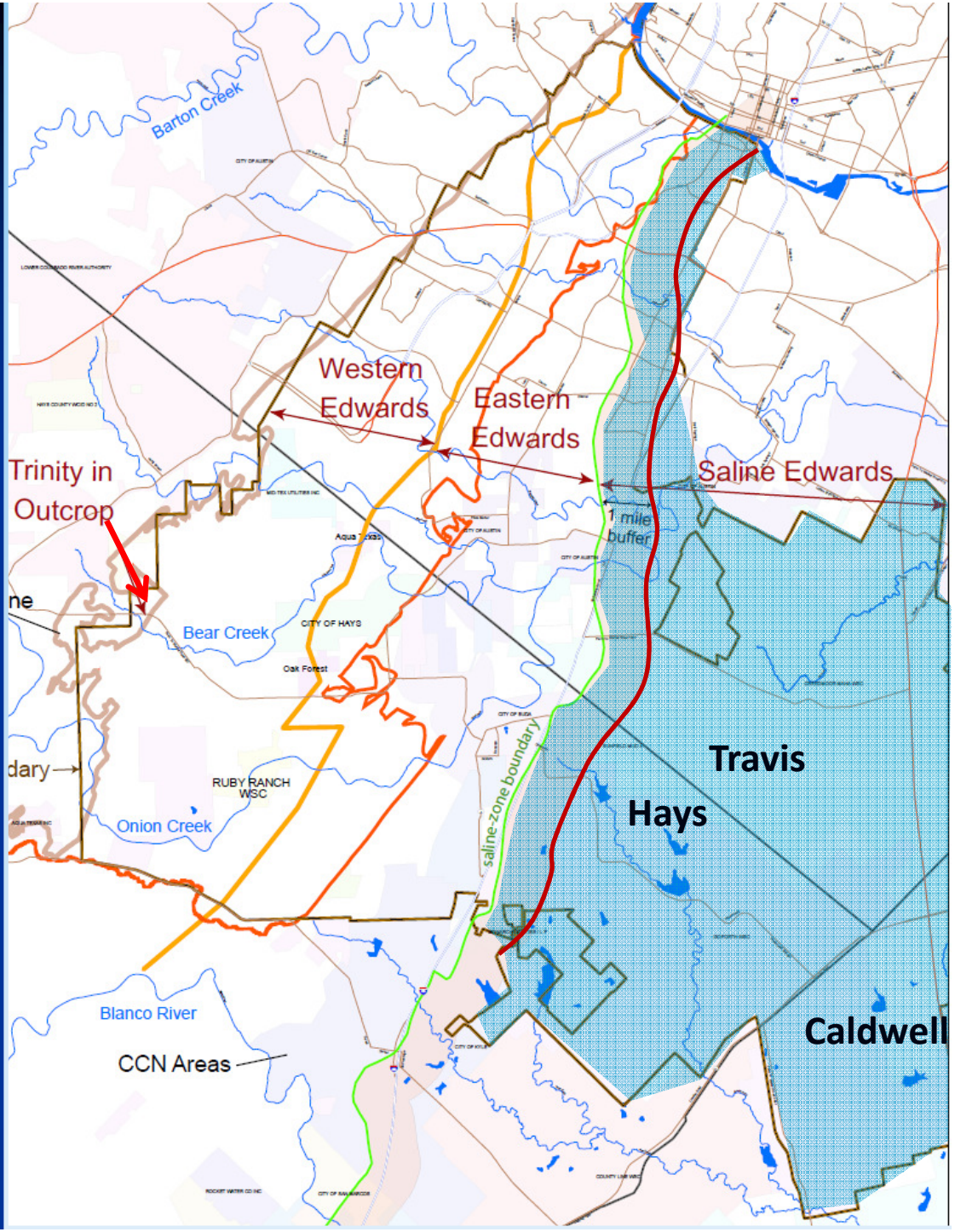
BSEACD District Boundaries



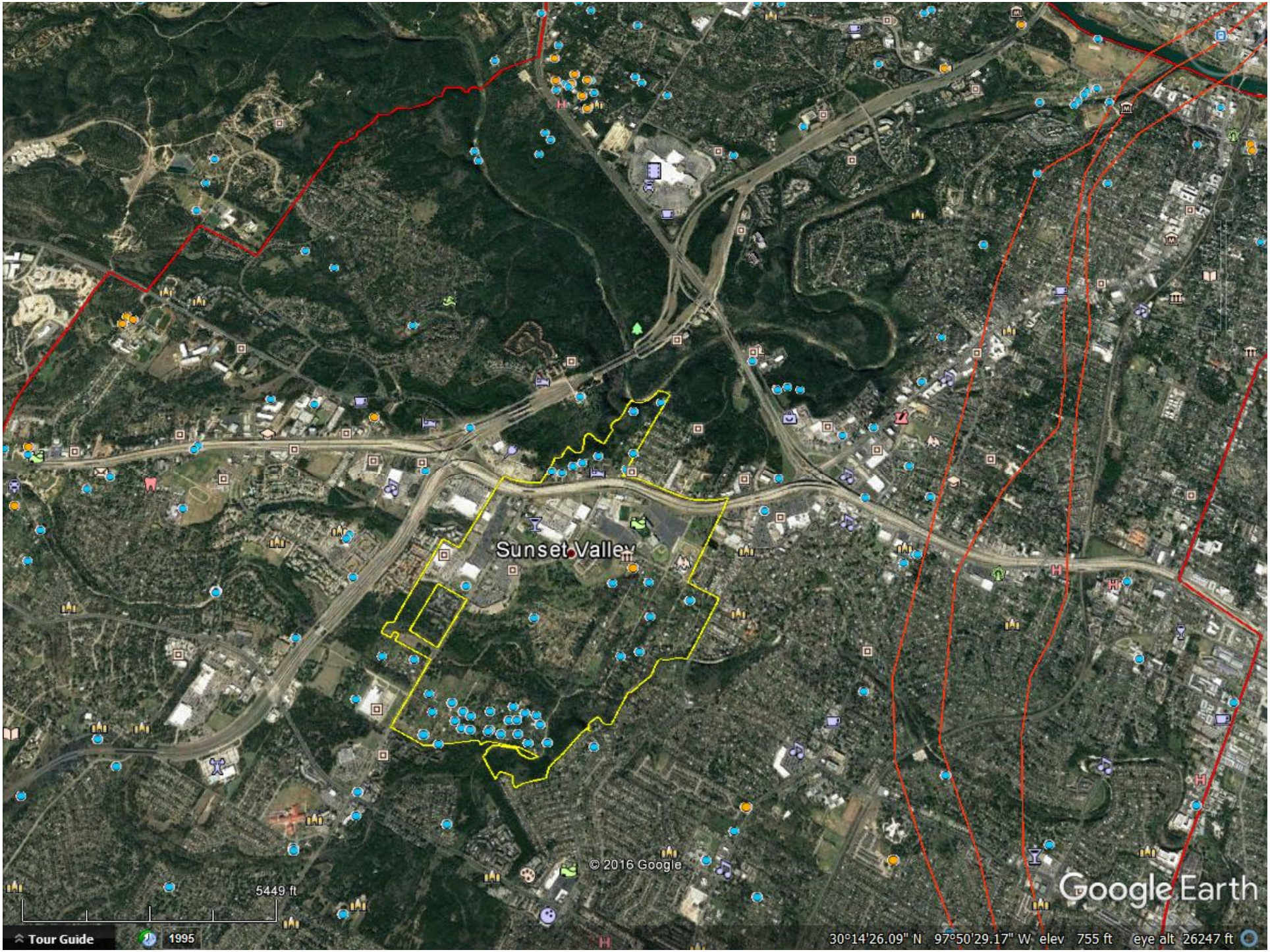
Barton Springs
Edwards Aquifer
Conservation District

Edwards Management Zones:

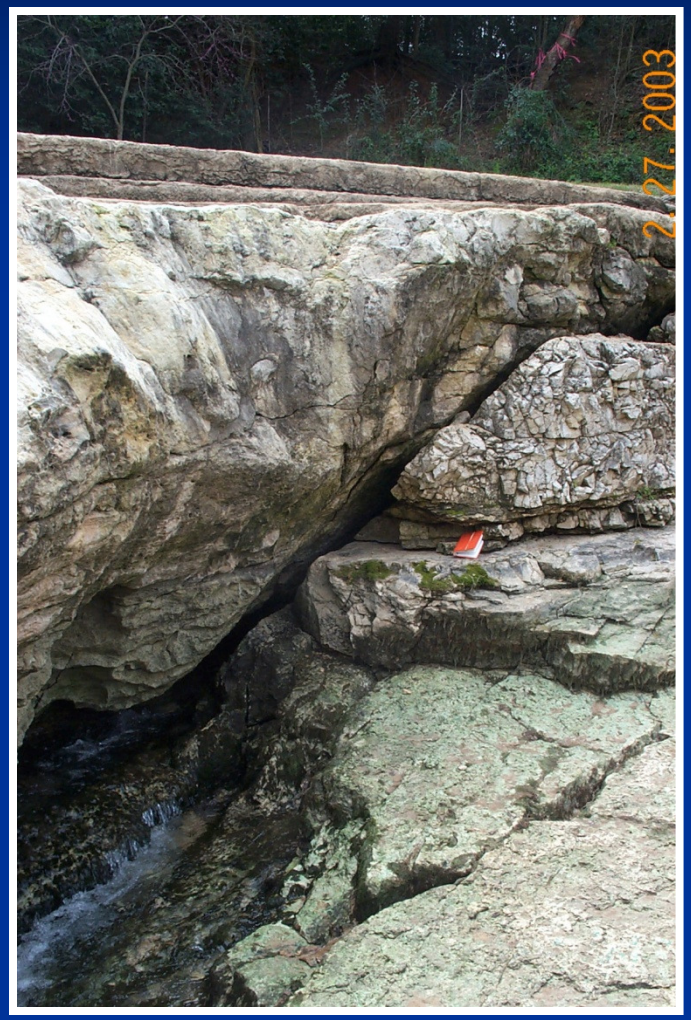
- No impacts to freshwater Edwards
- Not subject to drought rules
- “Historical” Permits up to MAG



Barton Springs Edwards Aquifer Conservation District


Sunset Valley
© 2016 Google
5449 ft
Google Earth
Tour Guide
1995
30°14'26.09" N 97°50'29.17" W elev 755 ft eye alt 26247 ft

Groundwater Tracing

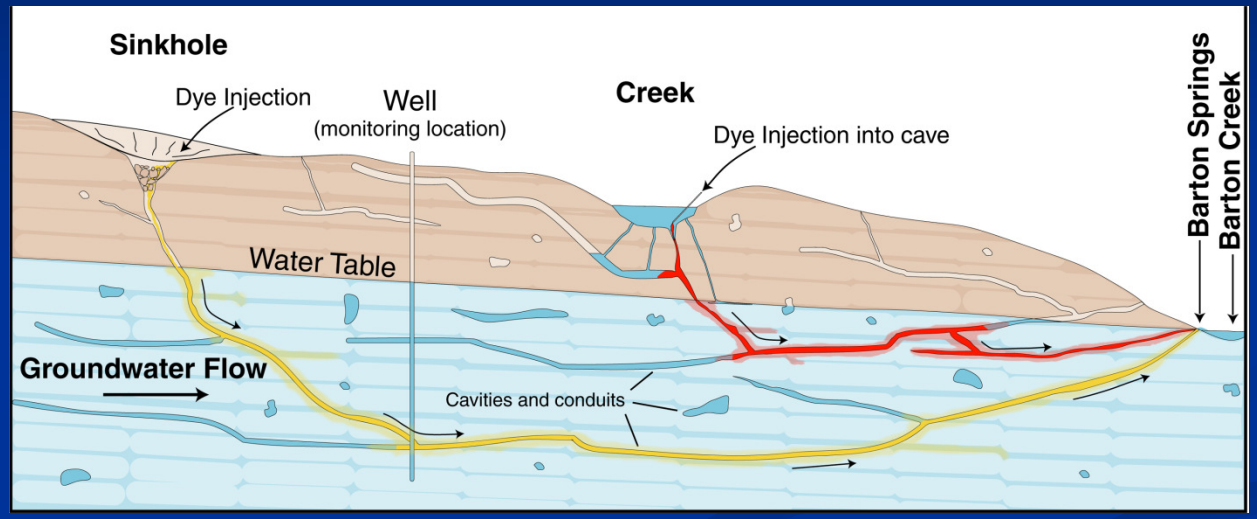


Significant conduit, fracture, and matrix (pore space) flow

Barton Springs
Edwards Aquifer
Conservation District

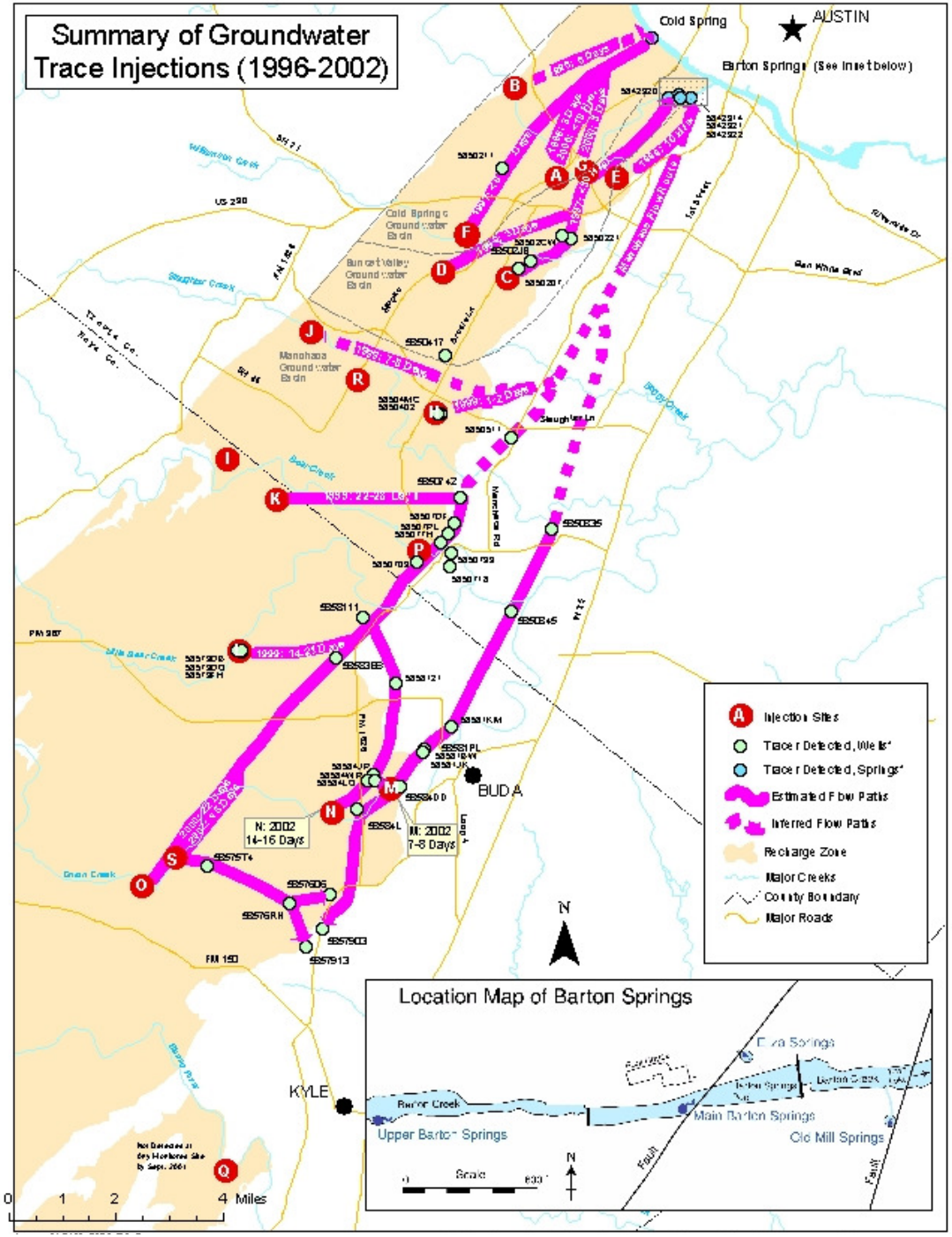
DYE-TRACE METHODS

(see Alexander and Quinlan, 1992)



- Inject non-toxic, organic, fluorescent (Sodium fluorescein and Eosine) dyes into caves along Onion Creek
- Monitor wells and springs
- Dye Detection
  - Qualitative (Spectrofluorometer)
  - Quantitative (Ozarka Underground Labs, Missouri)


HONDA



25 traces from 1996-2006

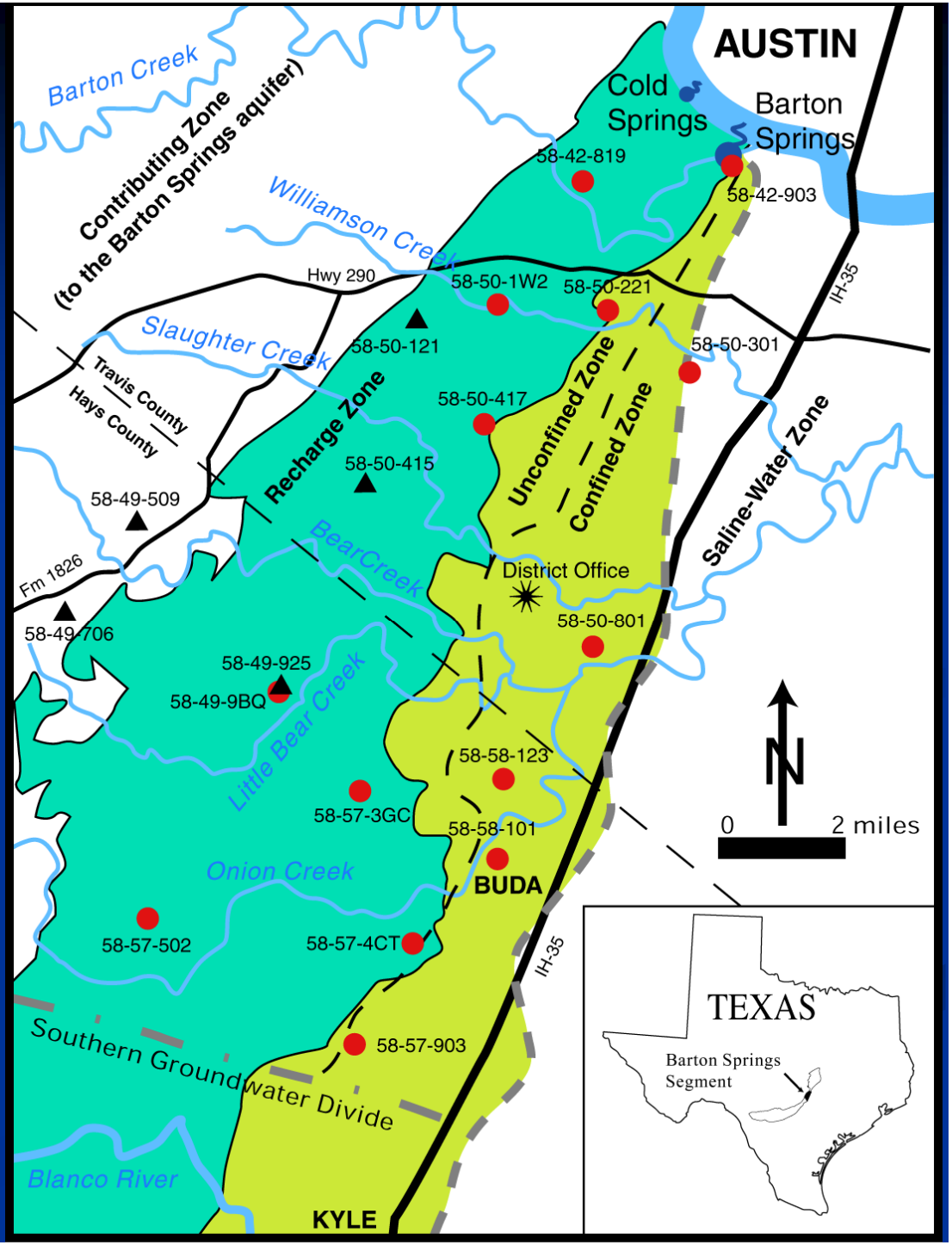
Flow rates up to 39,000 ft per day

Flow paths follow structures such as faults and fractures

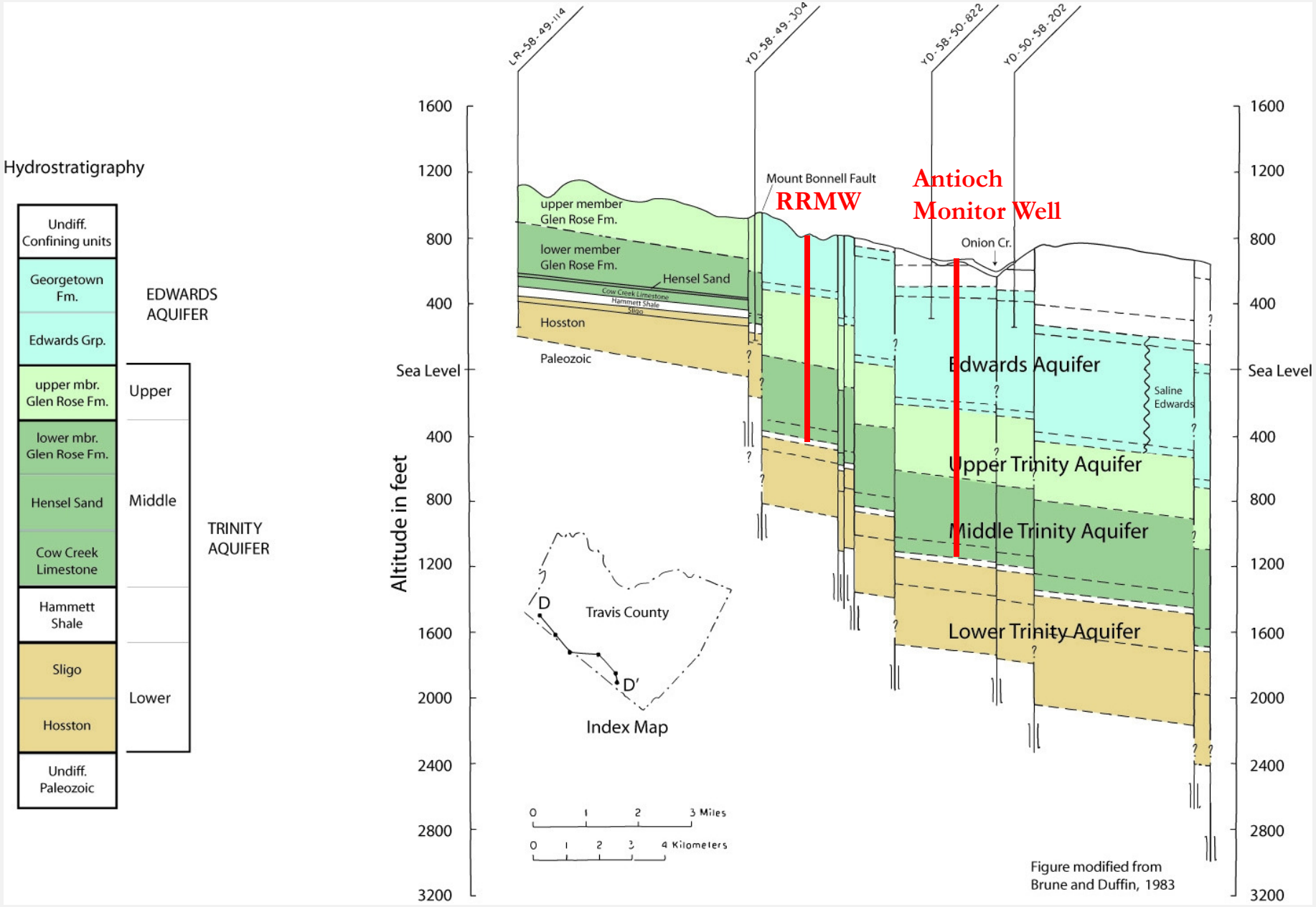
Airman’s Cave

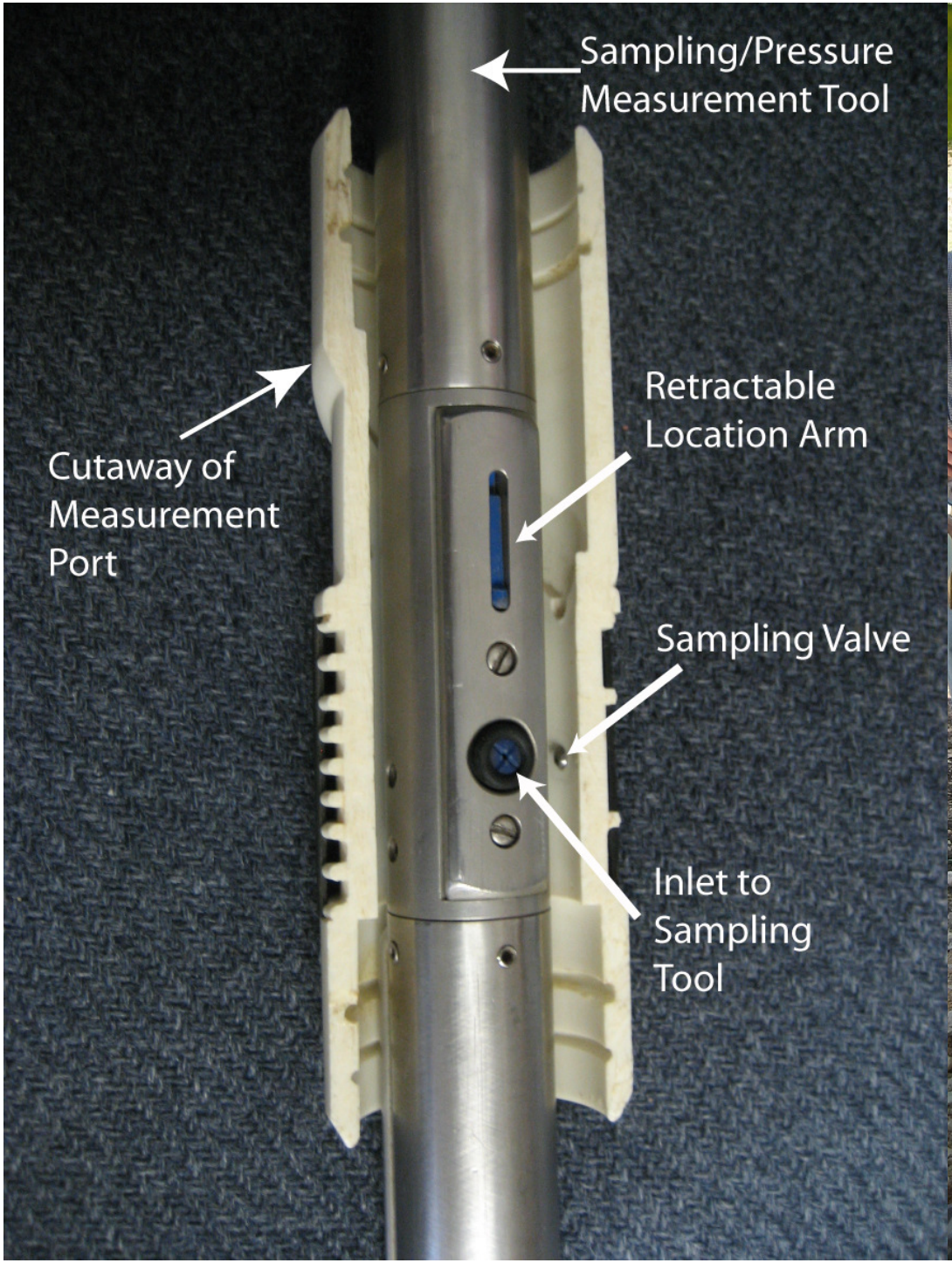
Zara Environmental LLC

Monitoring of the Edwards and Trinity Aquifers



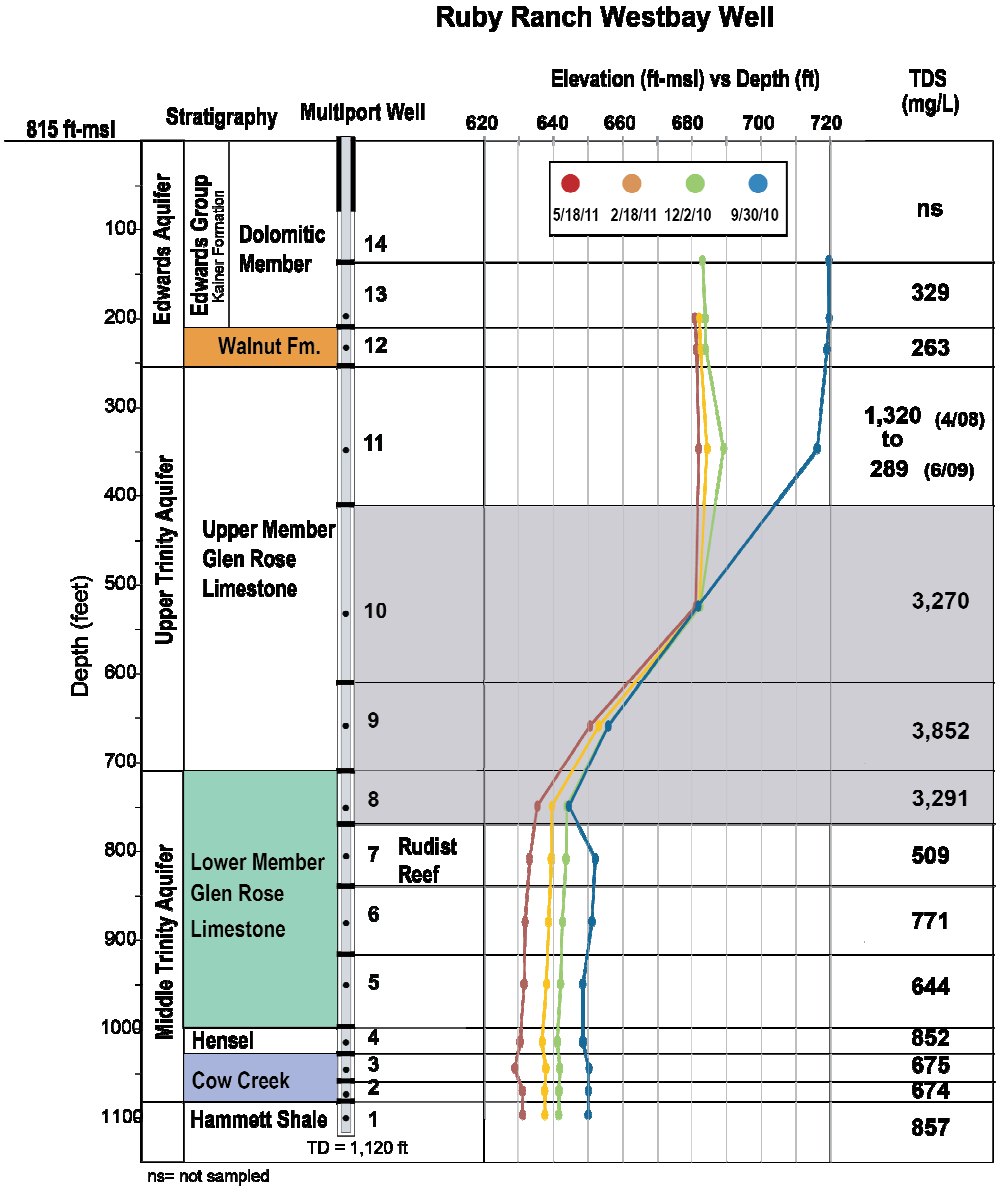
Barton Springs
Edwards Aquifer
Conservation District

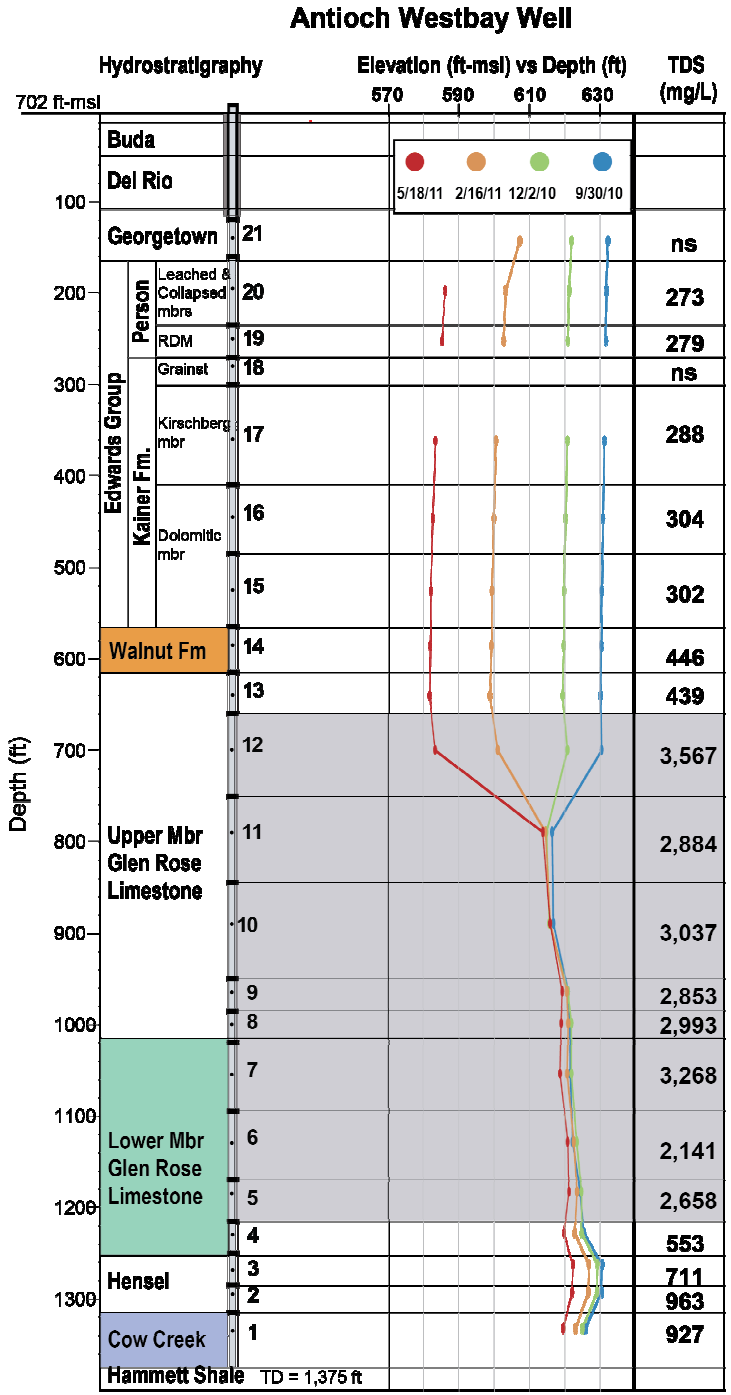

Hydrostratigraphy
Undiff. Confining units
Georgetown Fm.
Edwards Grp.
EDWARDS AQUIFER
upper mbr. Glen Rose Fm.
lower mbr. Glen Rose Fm.
Hensel Sand
Cow Creek Limestone
Hammett Shale
Sligo
Hosston
Upper
Middle
Lower
TRINITY AQUIFER
Undiff. Paleozoic
LR-58-49-114
YD-58-49-304
YD-58-50-822
YD-50-58-202
Mount Bonnell Fault
RRMW
Antioch Monitor Well
Onion Cr.
upper member Glen Rose Fm.
lower member Glen Rose Fm.
Hensel Sand
Cow Creek Limestone
Hammett Shale
Sligo
Hosston
Paleozoic
Edwards Aquifer
Saline Edwards
Upper Trinity Aquifer
Middle Trinity Aquifer
Lower Trinity Aquifer
Altitude in feet
Sea Level
1600
1200
800
400
2000
2400
2800
3200
D
D'
Travis County
Index Map
0 1 2 3 Miles
0 1 2 3 4 Kilometers
Figure modified from Brune and Duffin, 1983

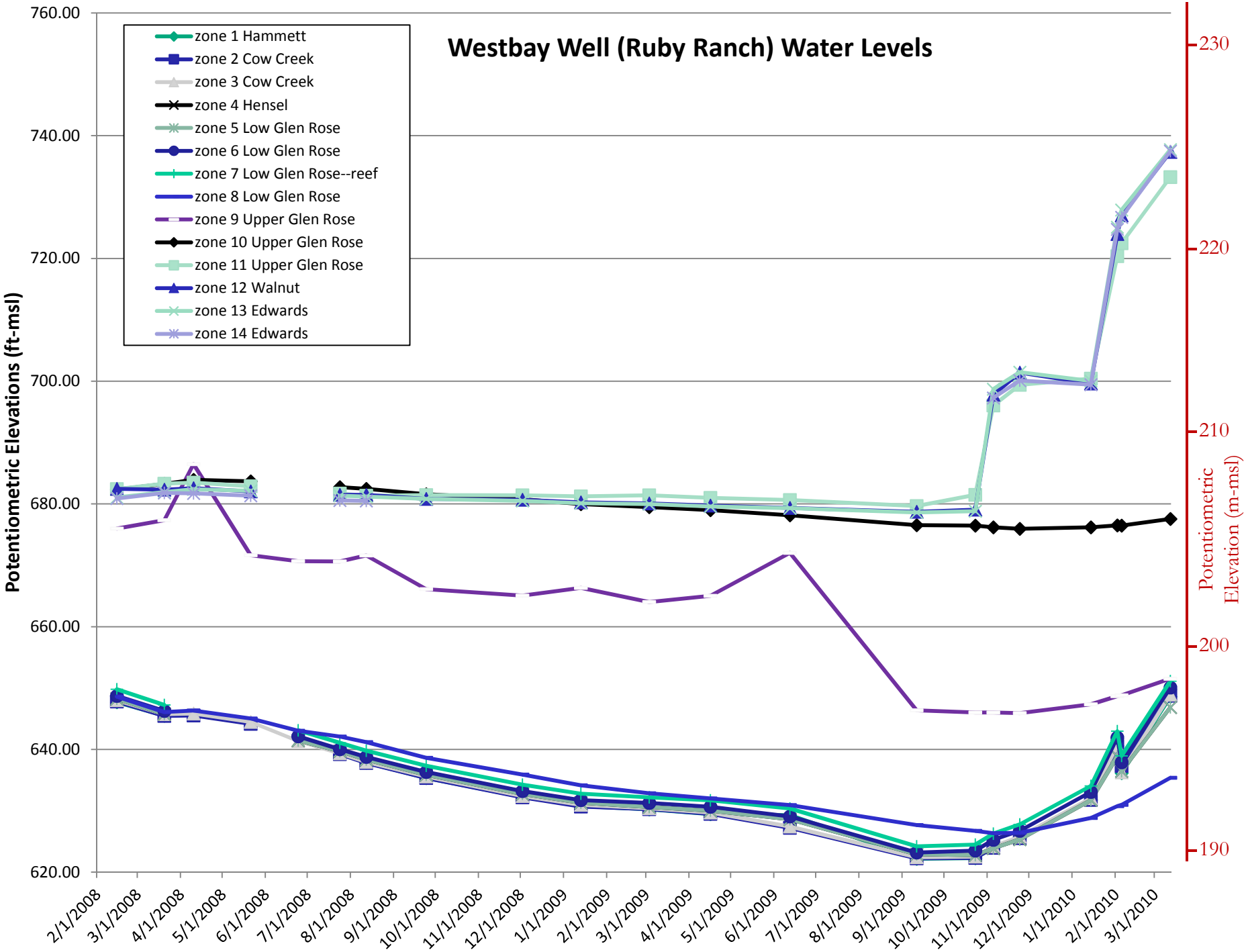

Sampling/Pressure Measurement Tool
Retractable Location Arm
Cutaway of Measurement Port
Sampling Valve
Inlet to Sampling Tool

Barton Springs
Edwards Aquifer
Conservation District

District Multiport Monitor Wells






Westbay Well (Ruby Ranch) Water Levels
zone 1 Hammett
zone 2 Cow Creek
zone 3 Cow Creek
zone 4 Hensel
zone 5 Low Glen Rose
zone 6 Low Glen Rose
zone 7 Low Glen Rose--reef
zone 8 Low Glen Rose
zone 9 Upper Glen Rose
zone 10 Upper Glen Rose
zone 11 Upper Glen Rose
zone 12 Walnut
zone 13 Edwards
zone 14 Edwards
Potentiometric Elevations (ft-msl)
760.00
740.00
720.00
700.00
680.00
660.00
640.00
620.00
Potentiometric Elevation (m-msl)
230
220
210
200
190
2/1/2008
3/1/2008
4/1/2008
5/1/2008
6/1/2008
7/1/2008
8/1/2008
9/1/2008
10/1/2008
11/1/2008
12/1/2008
1/1/2009
2/1/2009
3/1/2009
4/1/2009
5/1/2009
6/1/2009
7/1/2009
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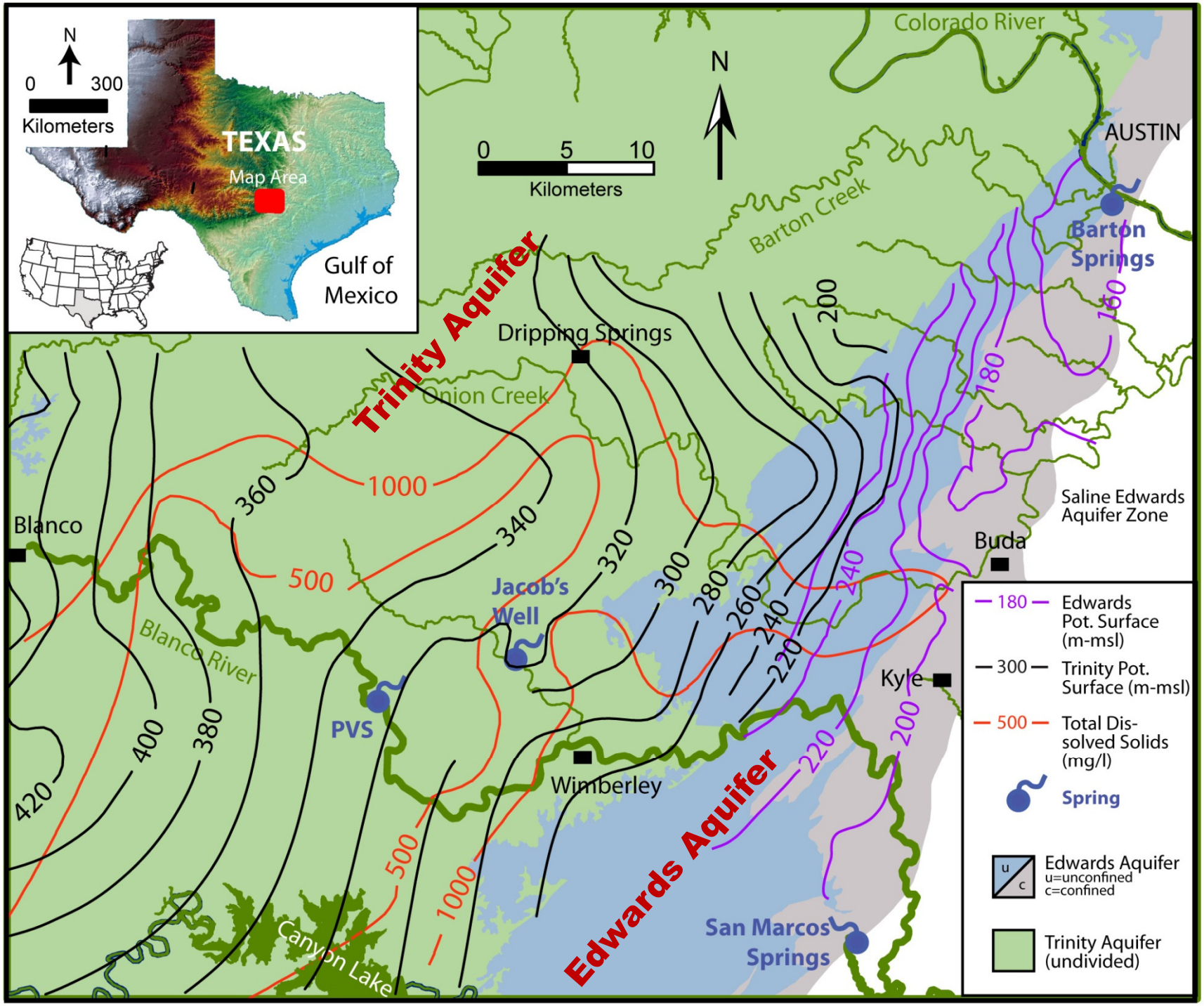
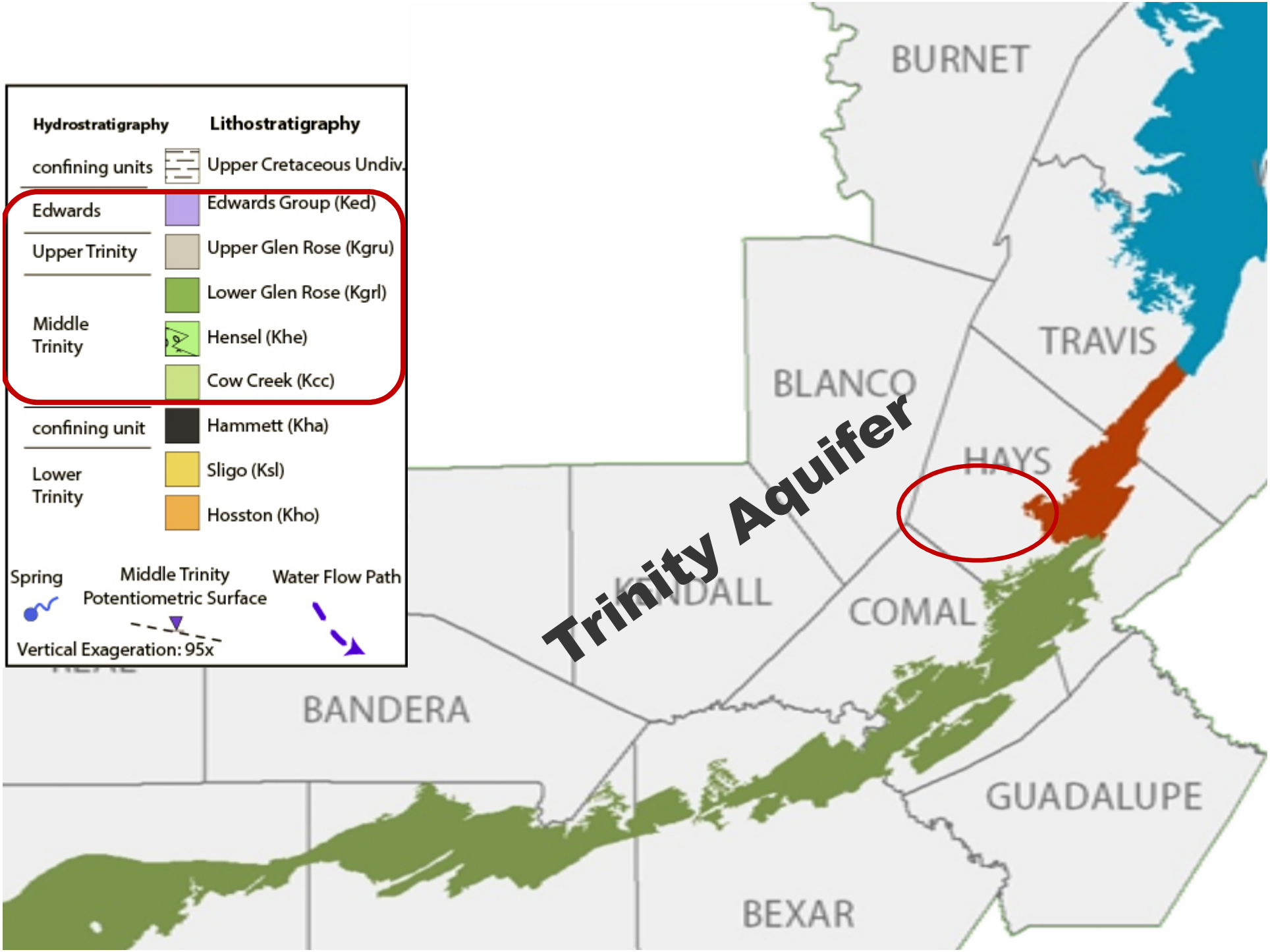
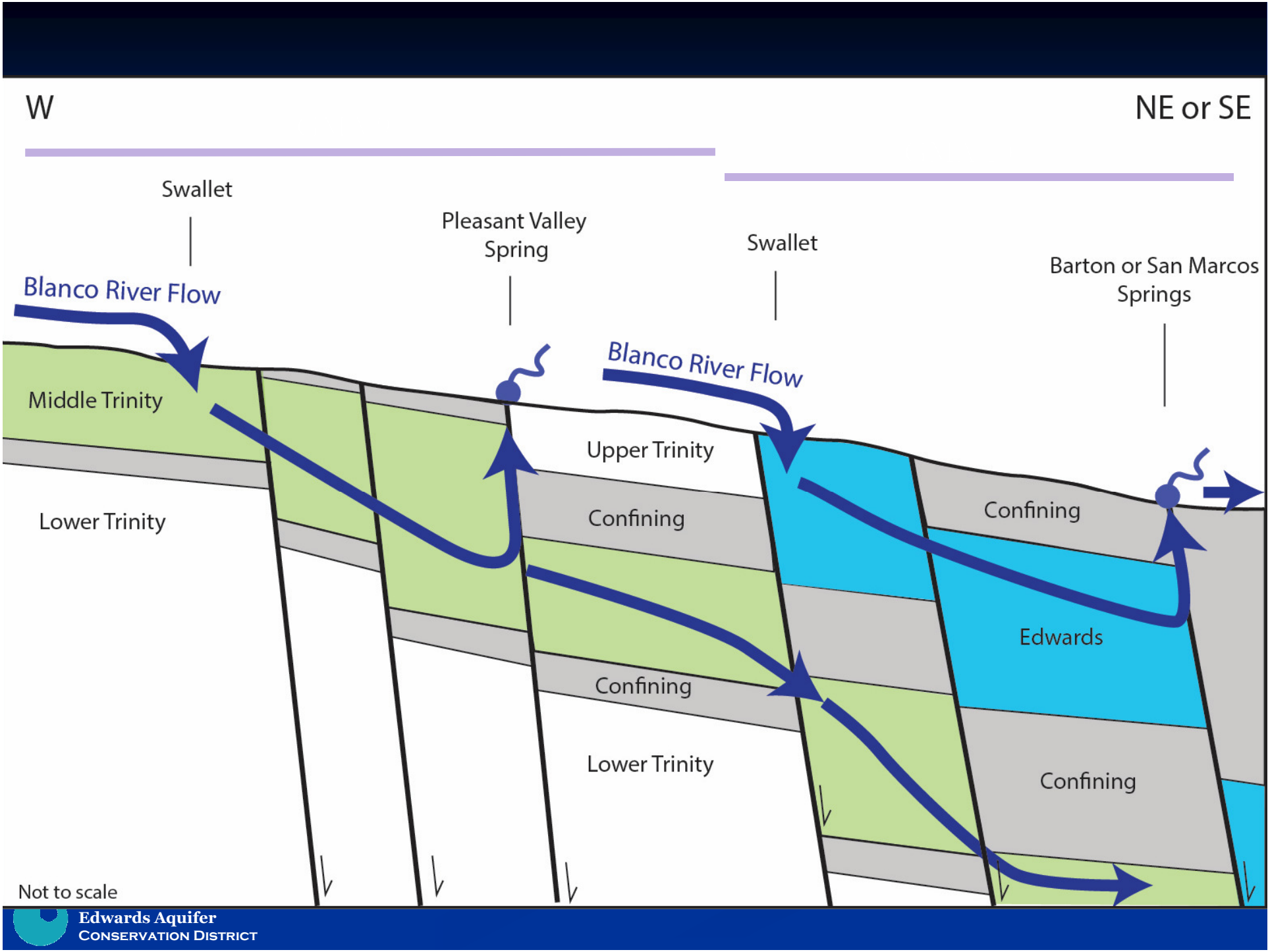
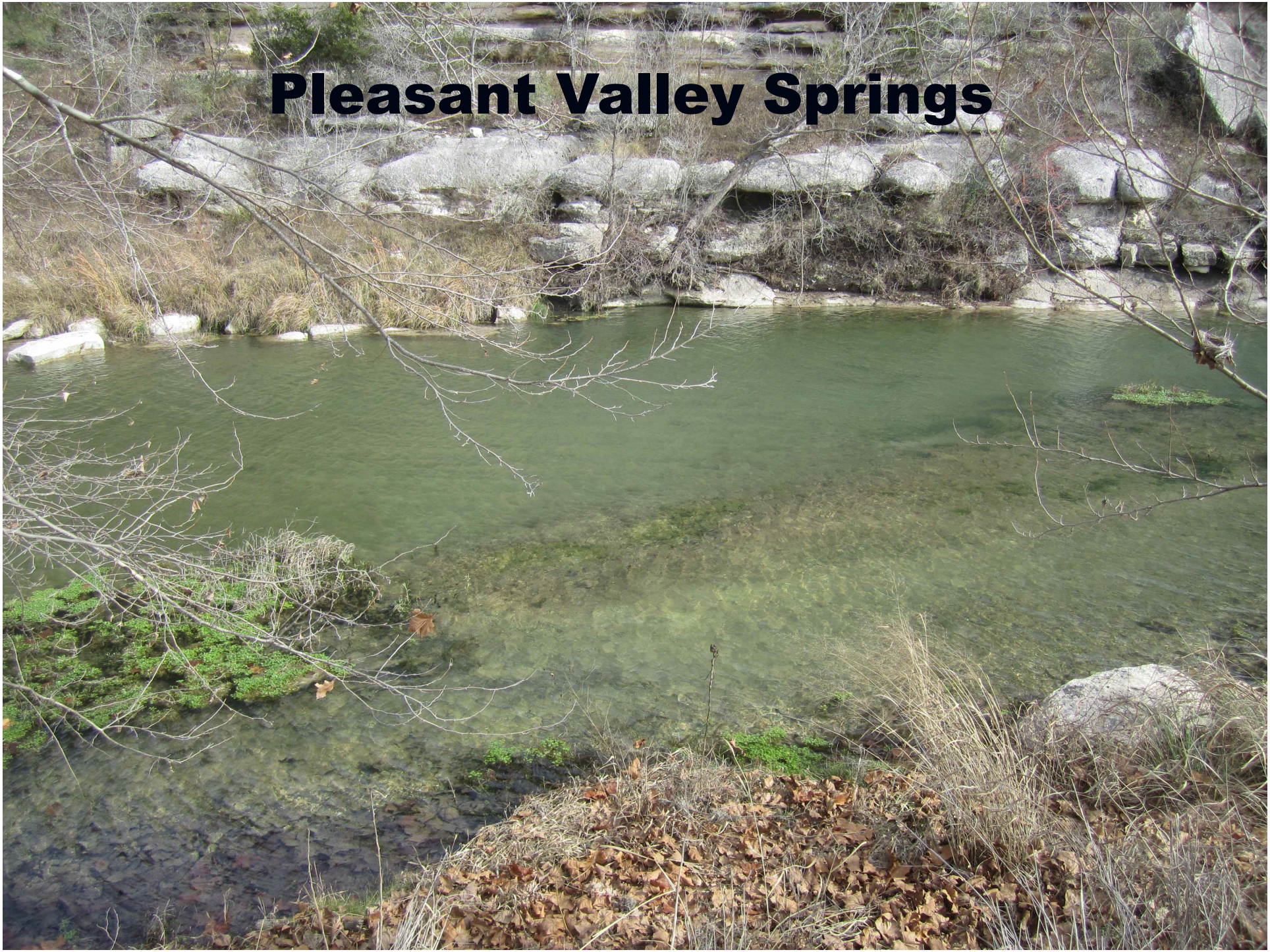
1/1/2010
2/1/2010
3/1/2010


N
0 300
Kilometers
TEXAS
Map Area
Gulf of Mexico
N
0 5 10
Kilometers
Colorado River
AUSTIN
Barton Creek
Barton Springs
Trinity Aquifer
Dripping Springs
Onion Creek
Blanco
Blanco River
Jacob's Well
PVS
Wimberley
Kyle
Buda
Saline Edwards Aquifer Zone
Edwards Aquifer
Canyon Lake
San Marcos Springs
180 Edwards Pot. Surface (m-msl)
300 Trinity Pot. Surface (m-msl)
500 Total Dissolved Solids (mg/l)
Spring
u/c Edwards Aquifer u=unconfined c=confined
Trinity Aquifer (undivided)

Hydrologic Influences of the Blanco River on the Trinity and Edwards Aquifers


Hydrostratigraphy
Lithostratigraphy
confining units
Upper Cretaceous Undiv.
Edwards
Edwards Group (Ked)
Upper Trinity
Upper Glen Rose (Kgru)
Lower Glen Rose (Kgrl)
Middle Trinity
Hensel (Khe)
Cow Creek (Kcc)
confining unit
Hammett (Kha)
Lower Trinity
Sligo (Ksl)
Hosston (Kho)
Spring
Middle Trinity Potentiometric Surface
Water Flow Path
Vertical Exageration: 95x
Trinity Aquifer
BURNET
TRAVIS
BLANCO
HAYS
KENDALL
COMAL
BANDERA
GUADALUPE
BEXAR


W
NE or SE
Swallet
Pleasant Valley Spring
Swallet
Barton or San Marcos Springs
Blanco River Flow
Blanco River Flow
Middle Trinity
Lower Trinity
Upper Trinity
Confining
Confining
Lower Trinity
Confining
Edwards
Confining
Not to scale


Pleasant Valley Springs

Jacob's Well Springs

Barton Springs
Edwards Aquifer
Conservation District


Managing Ground
Water Resources
During Drought

Drought Status Chart
Barton Springs/Edwards Aquifer Conservation District

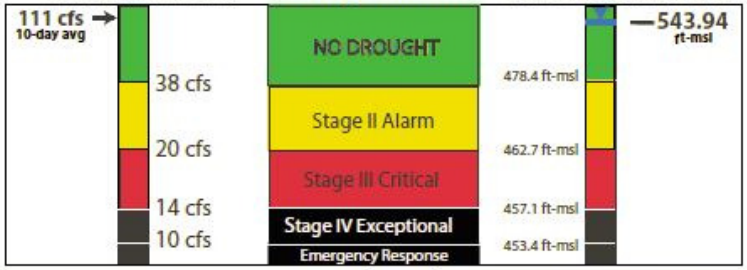
NO DROUGHT

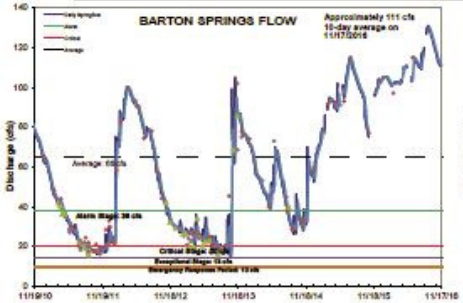
November 17, 2016

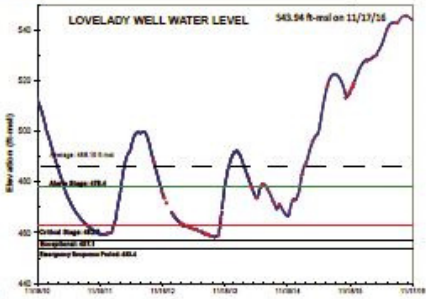
Barton Springs Discharge (cubic feet per second)
Previous value:112 cfs on 10/05/16

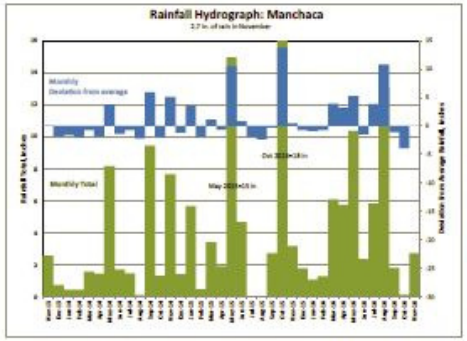
Drought Status

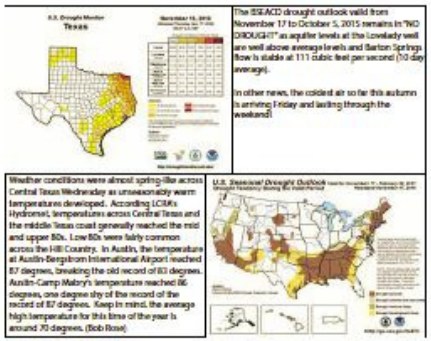
Lovelady Well Water Level Elevation (feet above mean sea level)
Previous value: 545.80 ft-msl on 10/05/16









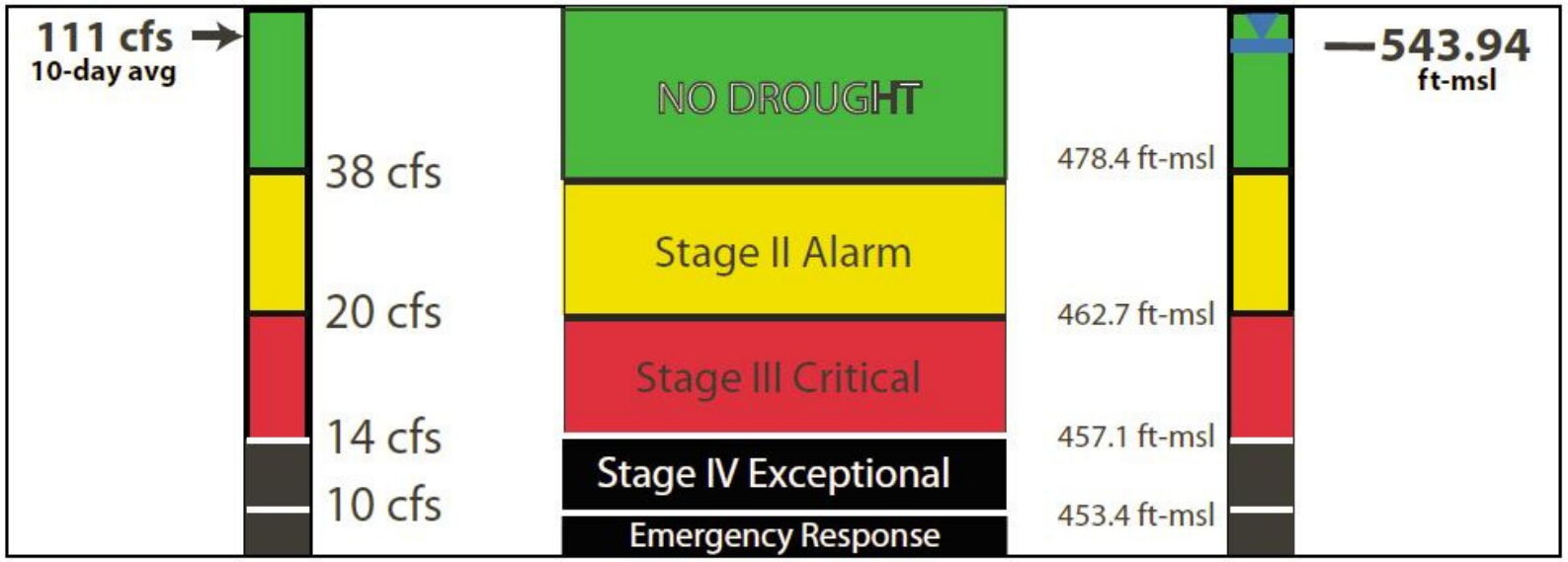


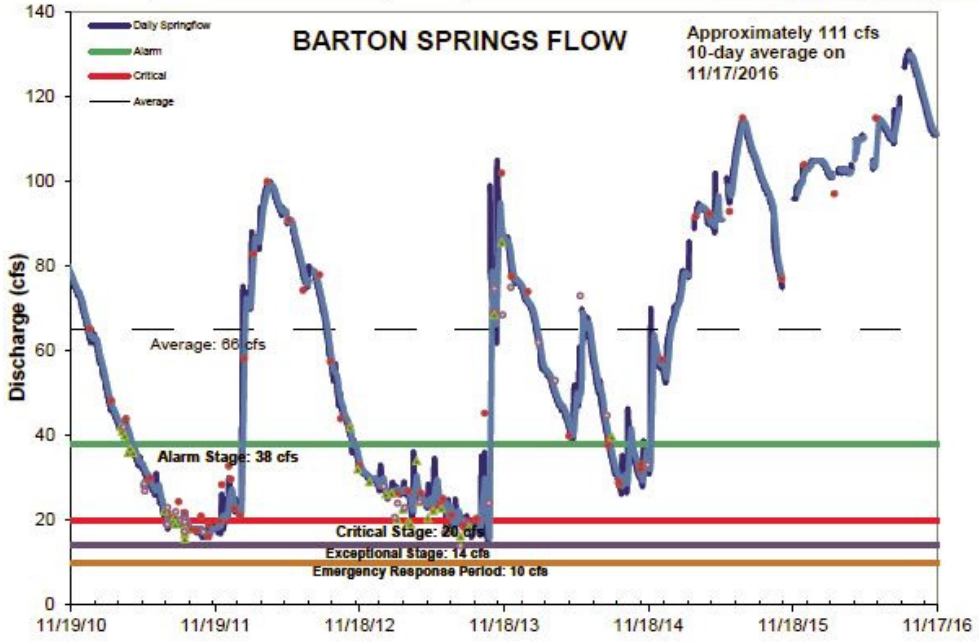
The ISEACD drought outlook valid from November 17 to October 5, 2015 remains in "NO DROUGHT" as aquifer levels at the Lovelady well are well above average levels and Barton Springs flow is stable at 111 cubic feet per second (10 day average).

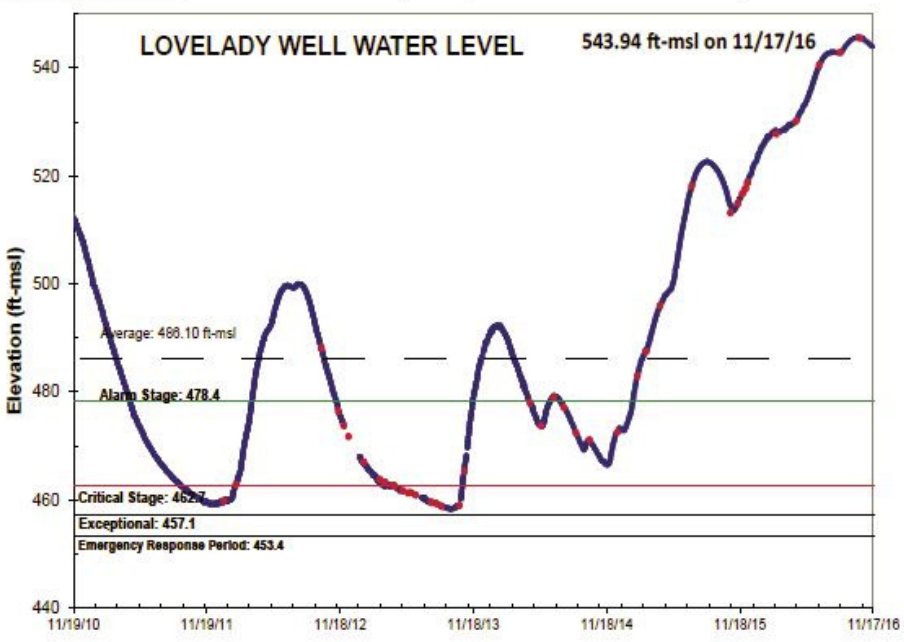
In other news, the coldest air so far this autumn is arriving Friday and lasting through the weekend!

Weather conditions were almost spring-like across Central Texas Wednesday as unseasonably warm temperatures developed. According LCRA's Hydromet, temperatures across Central Texas and the middle Texas coast generally reached the mid and upper 80s. Low 80s were fairly common across the Hill Country. In Austin, the temperature at Austin-Bergstrom International Airport reached 87 degrees, breaking the old record of 83 degrees. Austin-Camp Mabry's temperature reached 86 degrees, one degree shy of the record of the record of 87 degrees. Keep in mind, the average high temperature for this time of the year is around 70 degrees. (Bob Rose)

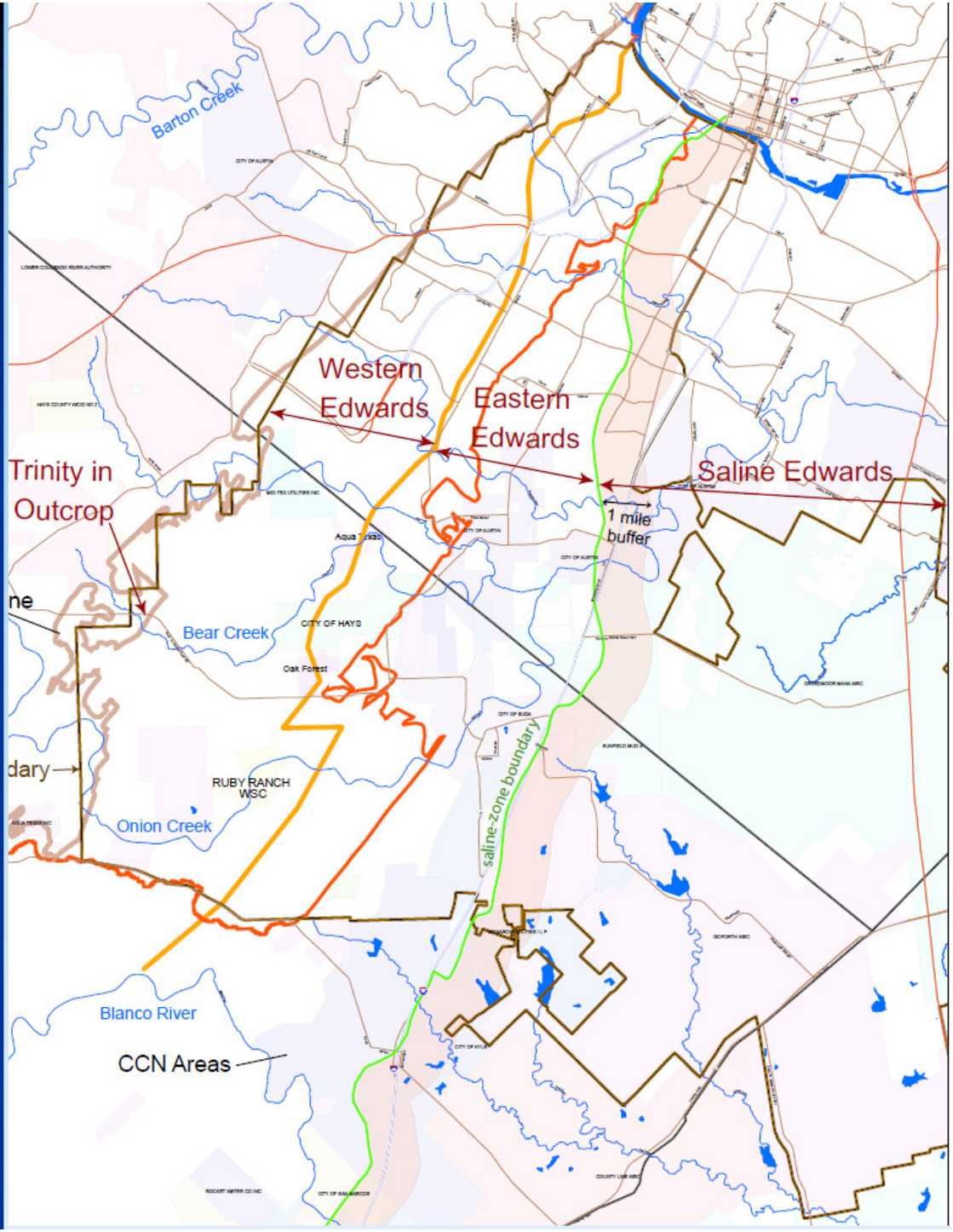
Barton Springs
Edwards Aquifer
Conservation District


111 cfs
10-day avg
38 cfs
20 cfs
14 cfs
10 cfs
NO DROUGHT
Stage II Alarm
Stage III Critical
Stage IV Exceptional
Emergency Response
478.4 ft-msl
462.7 ft-msl
457.1 ft-msl
453.4 ft-msl
543.94
ft-msl

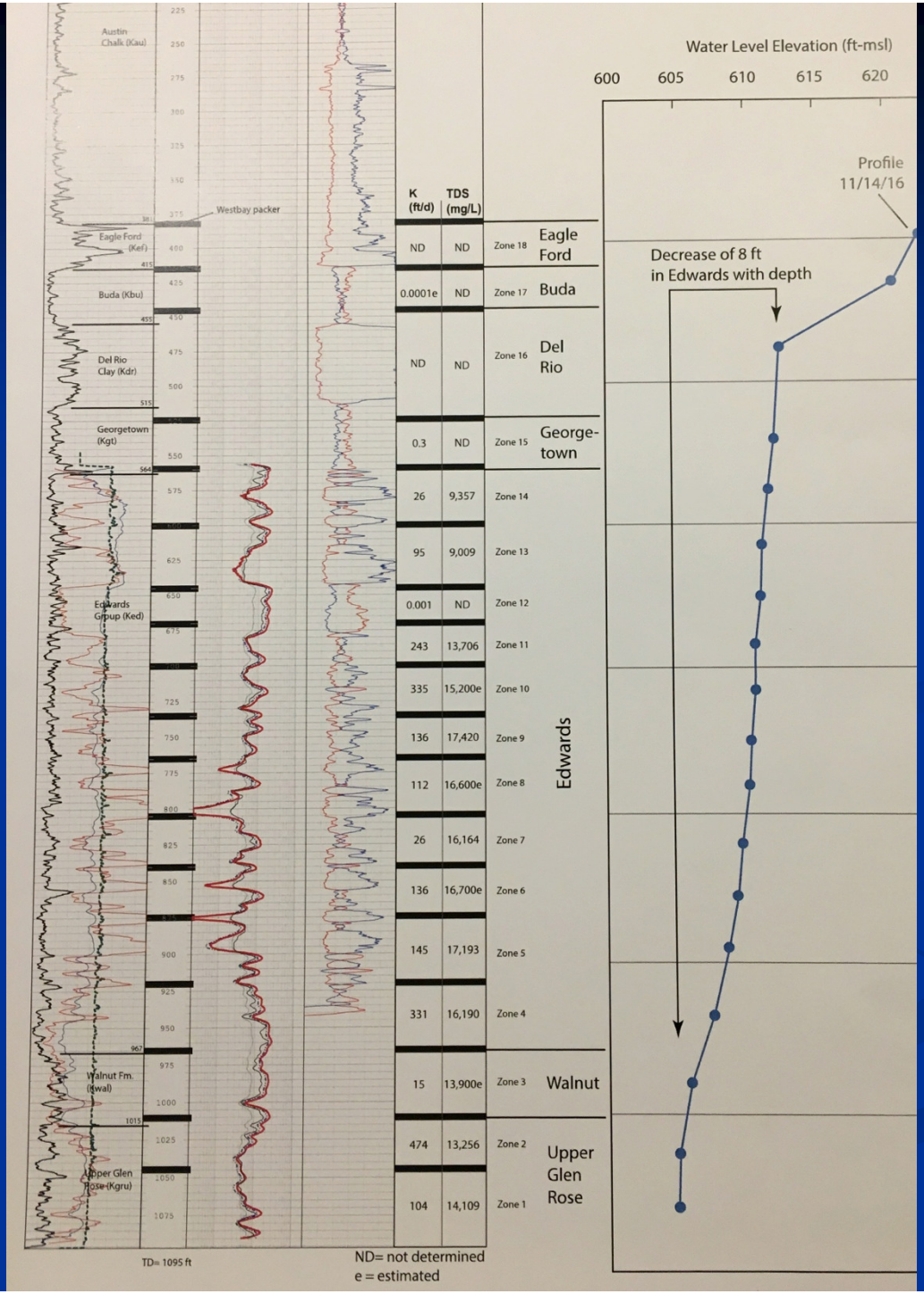

BARTON SPRINGS FLOW
Approximately 111 cfs
10-day average on
11/17/2016
Daily Springflow
Alarm
Critical
Average
Discharge (cfs)
Average: 66 cfs
Alarm Stage: 38 cfs
Critical Stage: 20 cfs
Exceptional Stage: 14 cfs
Emergency Response Period: 10 cfs
140
120
100
80
60
40
20
0
11/19/10
11/19/11
11/18/12
11/18/13
11/18/14
11/18/15
11/17/16


LOVELADY WELL WATER LEVEL
543.94 ft-msl on 11/17/16
Elevation (ft-msl)
Average: 488.10 ft-msl
Alarm Stage: 478.4
Critical Stage: 462.7
Exceptional: 457.1
Emergency Response Period: 453.4
540
520
500
480
460
440
11/19/10
11/19/11
11/18/12
11/18/13
11/18/14
11/18/15
11/17/16

ASR and Desalination in the Trinity and Saline Edwards Aquifers



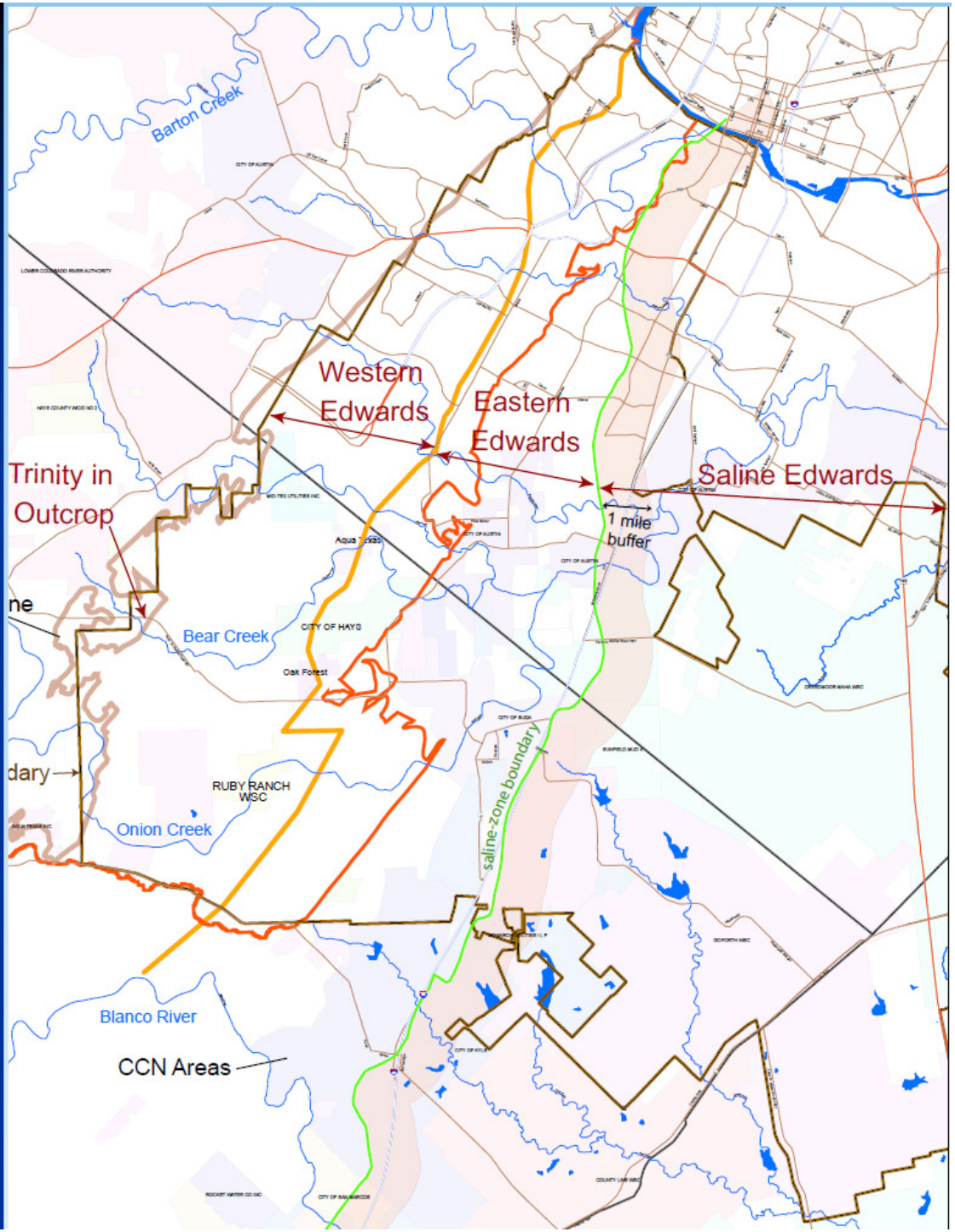
Barton Springs
Edwards Aquifer
Conservation District



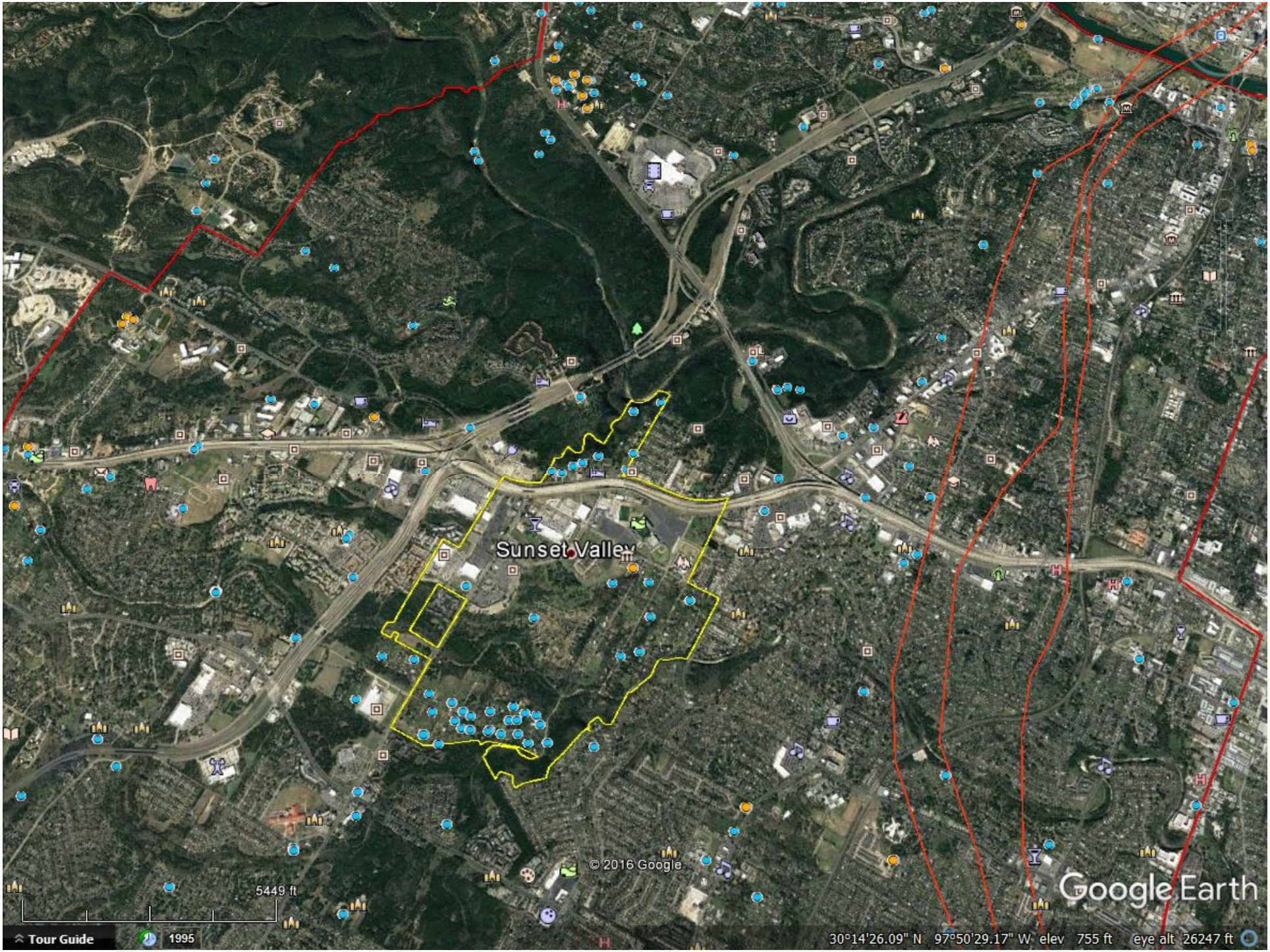
Barton Springs
Edwards Aquifer
Conservation District

Potential ASR Sites

- Ruby Ranch
- City of Buda
- City of Austin
- TDS Landfill



Barton Springs Edwards Aquifer Conservation District


Sunset Valley
© 2016 Google
5449 ft
Google Earth
Tour Guide
1995
30°14'26.09" N 97°50'29.17" W elev 755 ft eye alt 26247 ft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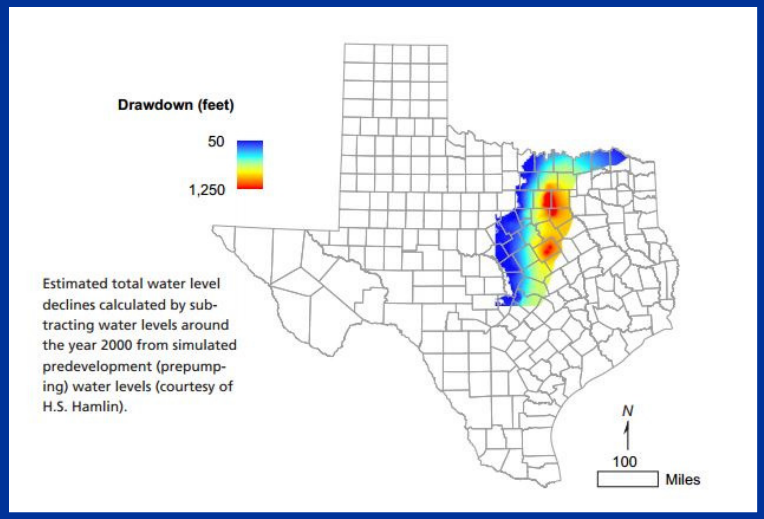
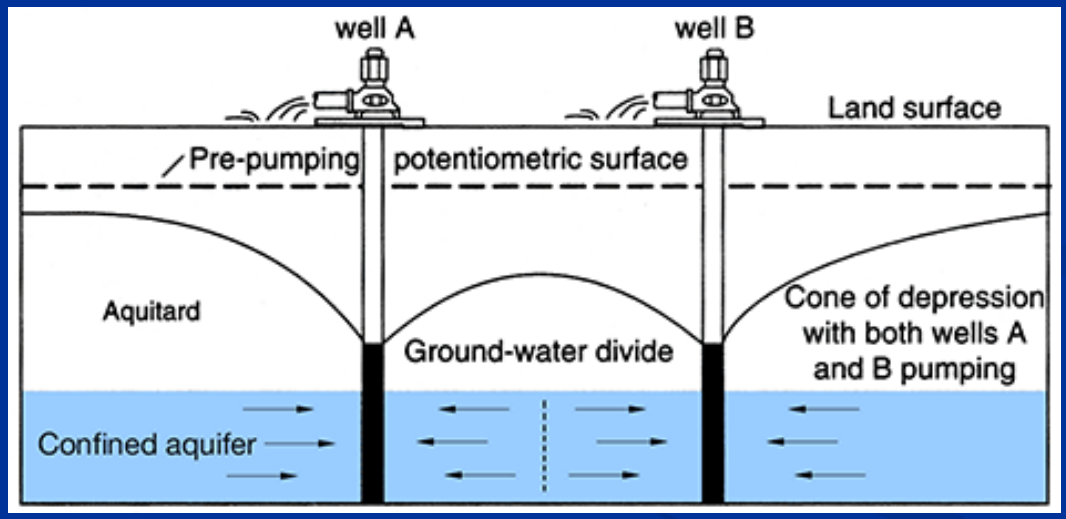
Unreasonable Impacts: Assessing the Impacts of Pumping for Permitting Considerations





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Generalized Stratigraphy of the Edwards and Trinity Aquifers

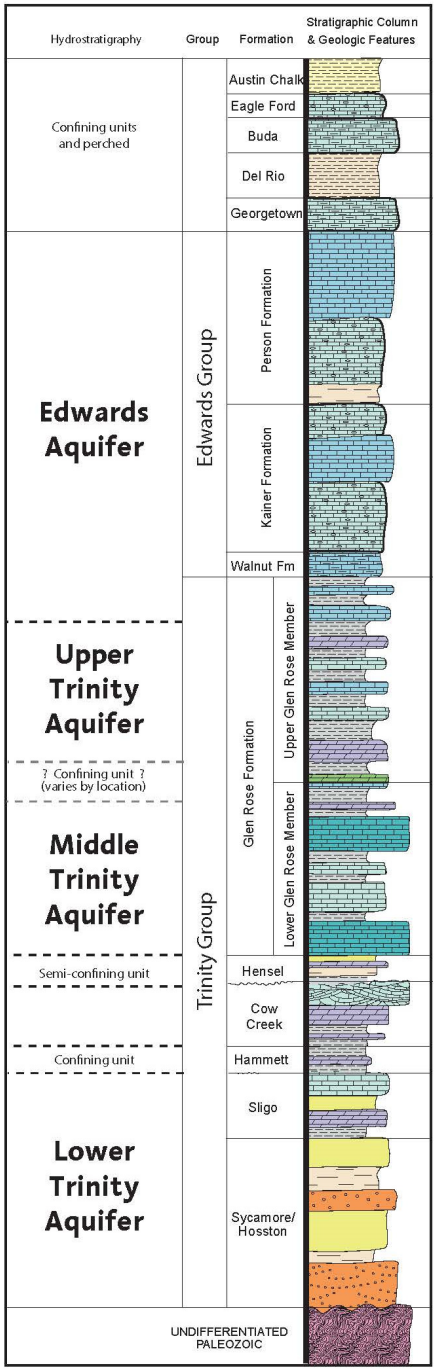

Figure modified from Wierman et al., 2010
Stratigraphic notes:
1 - Edwards Group, Kainer Fm, as defined by Rose (1972).
2 - Ages and sequence boundaries from Scott et al. (2007).

For additional detail, see Hydrogeologic atlas of the Hill Country Trinity Aquifer, Blanco, Hays and Travis Counties, central Texas, Plate 2: Stratigraphic Column and Type Geophysical Logs
http://repositories.lib.utexas.edu/handle/2152/8977

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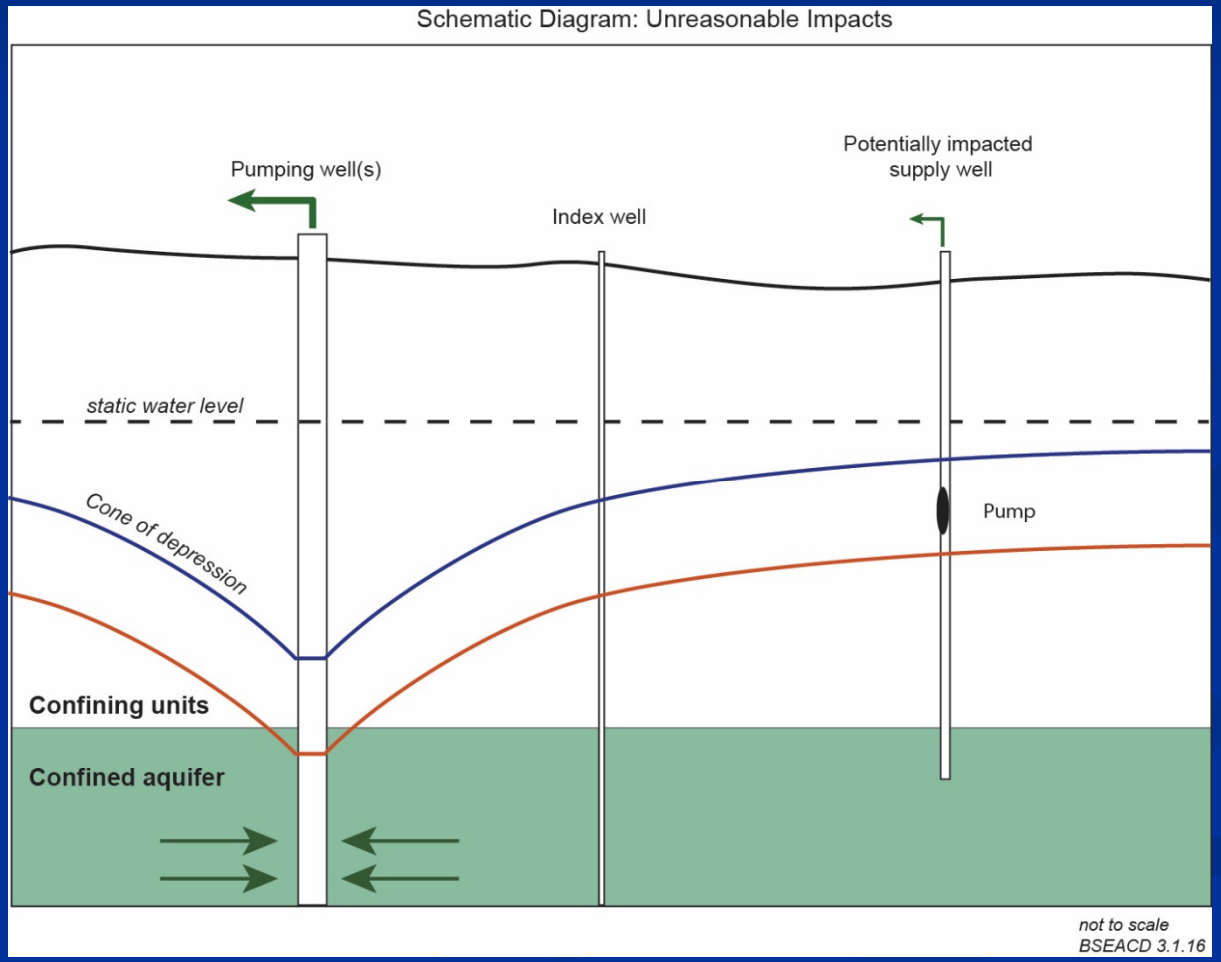
Local Approach: Well interference (Unreasonable Impacts)



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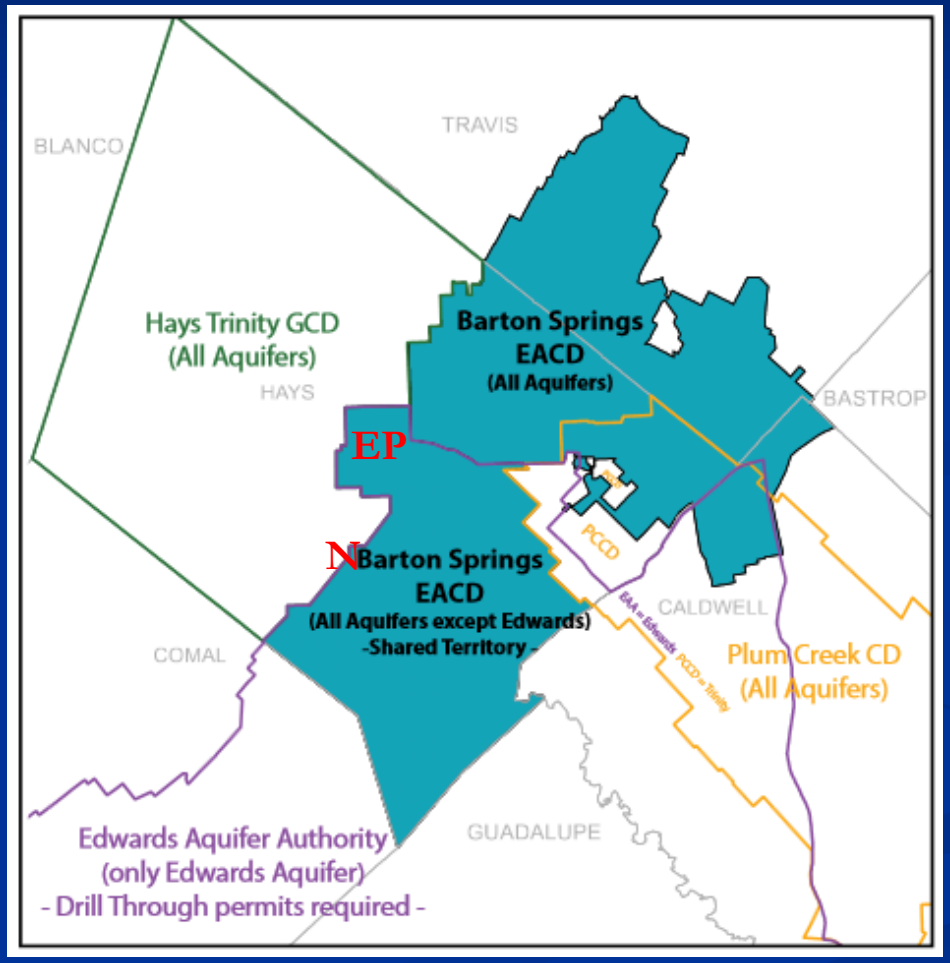
New Middle Trinity Permit Requests



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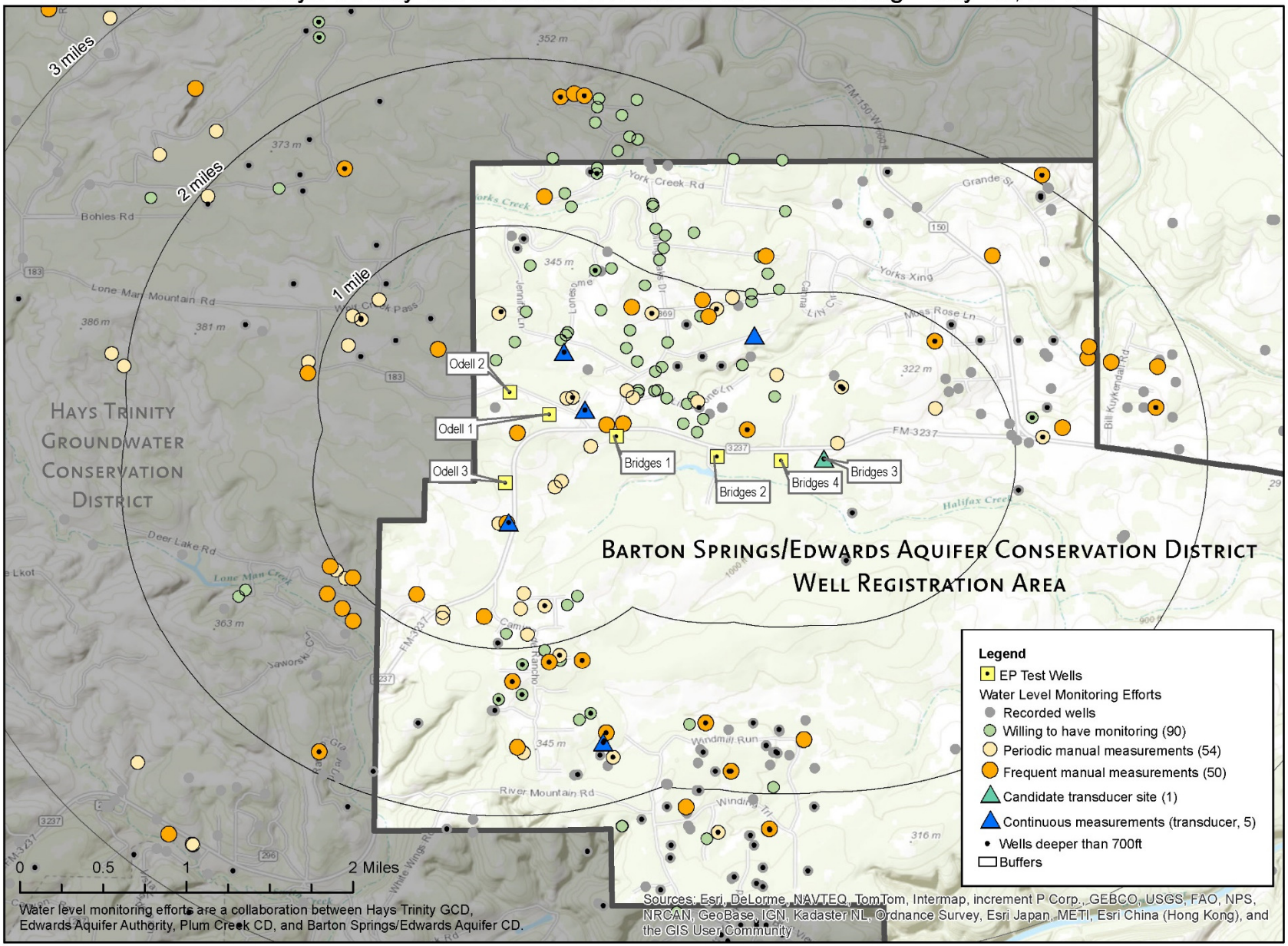
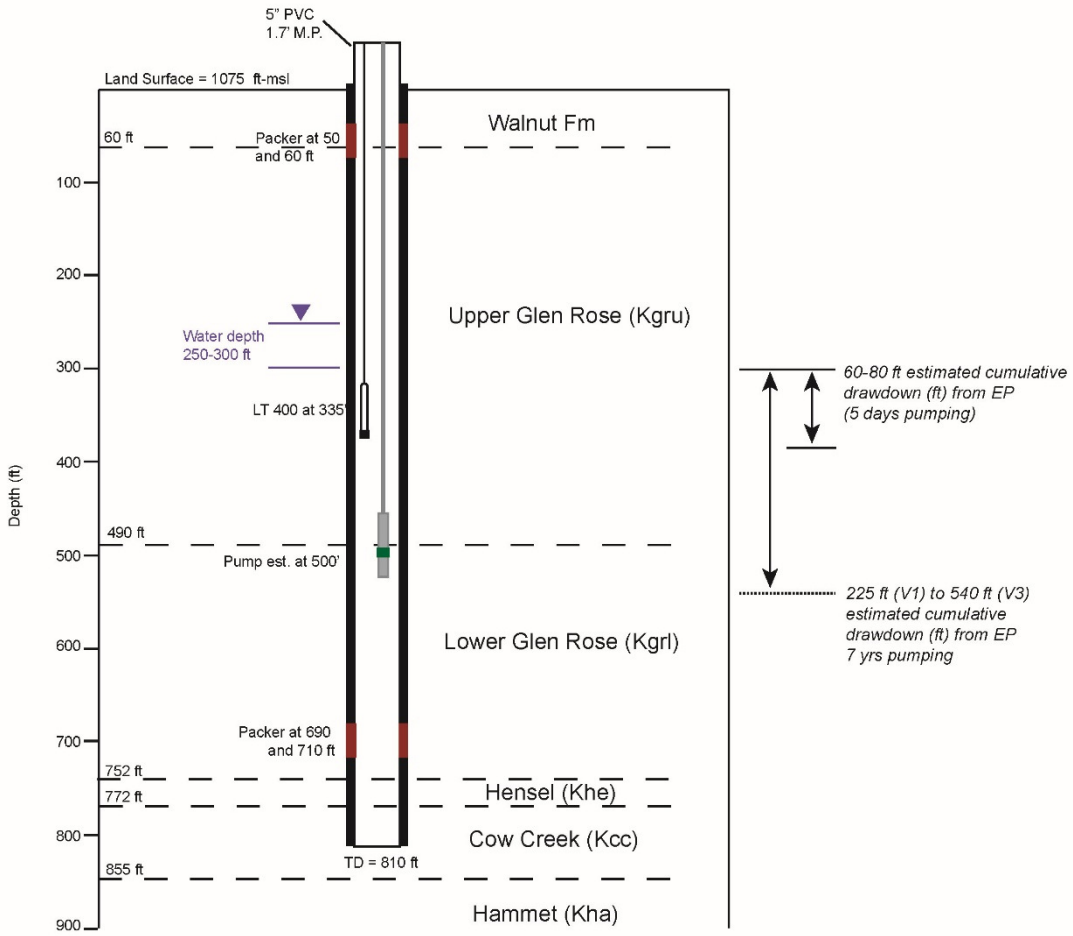
Central Hays County Groundwater Evaluation Well Monitoring - July 28, 2015



Ochoa Monitor Well Diagram



Construction Notes:
5" PVC from +1.7 to 810 ft;
Cemented from surface to 50 ft.
Assume slotted at Kcc.

BSEACD 1/15/16

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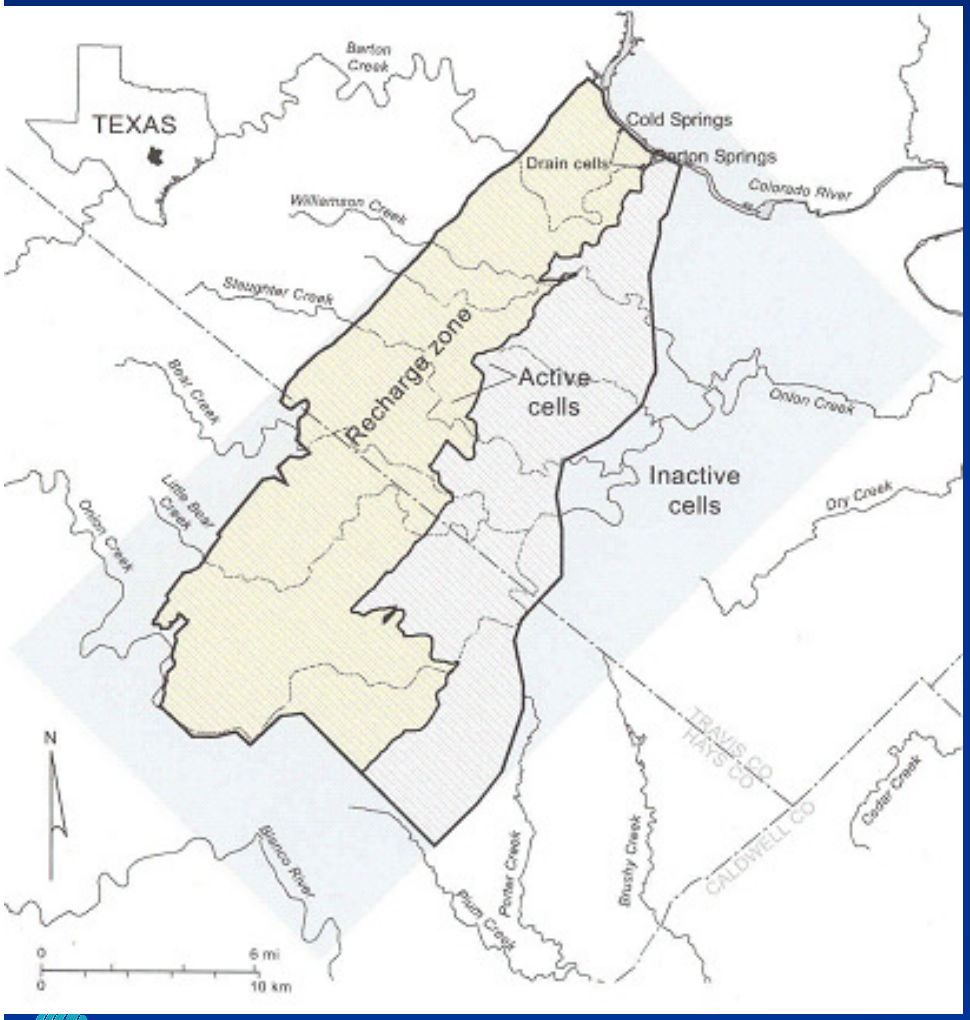
Sustainable Yield Modeling

Definition of Sustainable Yield:

Safe [sustainable] yield is the rate at which water can be withdrawn from an aquifer without producing an **undesired result-** D. K. Todd, 1959

Groundwater Availability Model

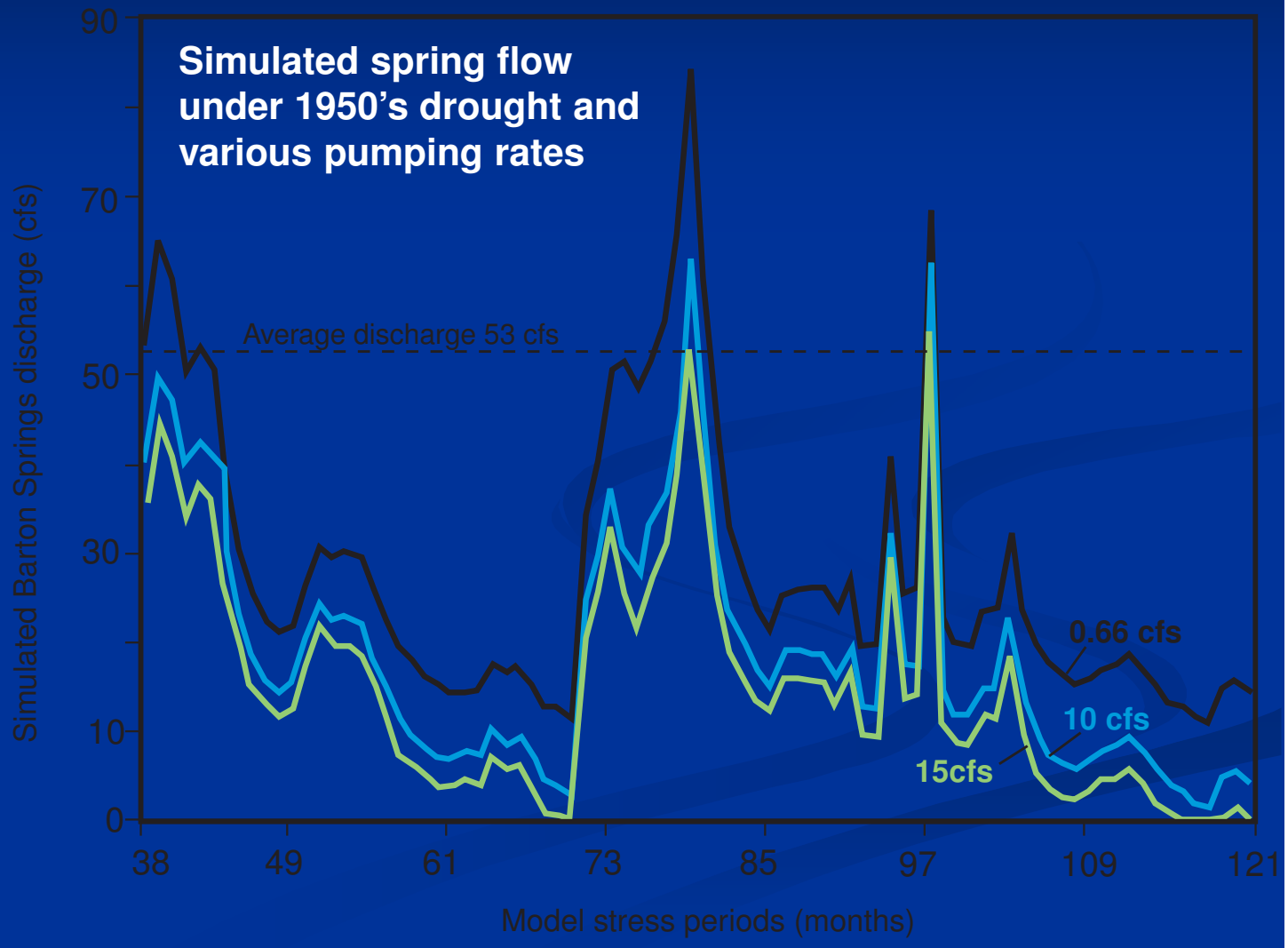


GAM is an initiative by TWDB to develop state of the art, publicly available, numerical groundwater flow models to provide reliable information of groundwater availability in Texas.

Barton Springs GAM:

- Scanlon et al., 2000 and 2001
- Recalibrated to better-match 1950's drought conditions

GAM Simulated Spring Flow



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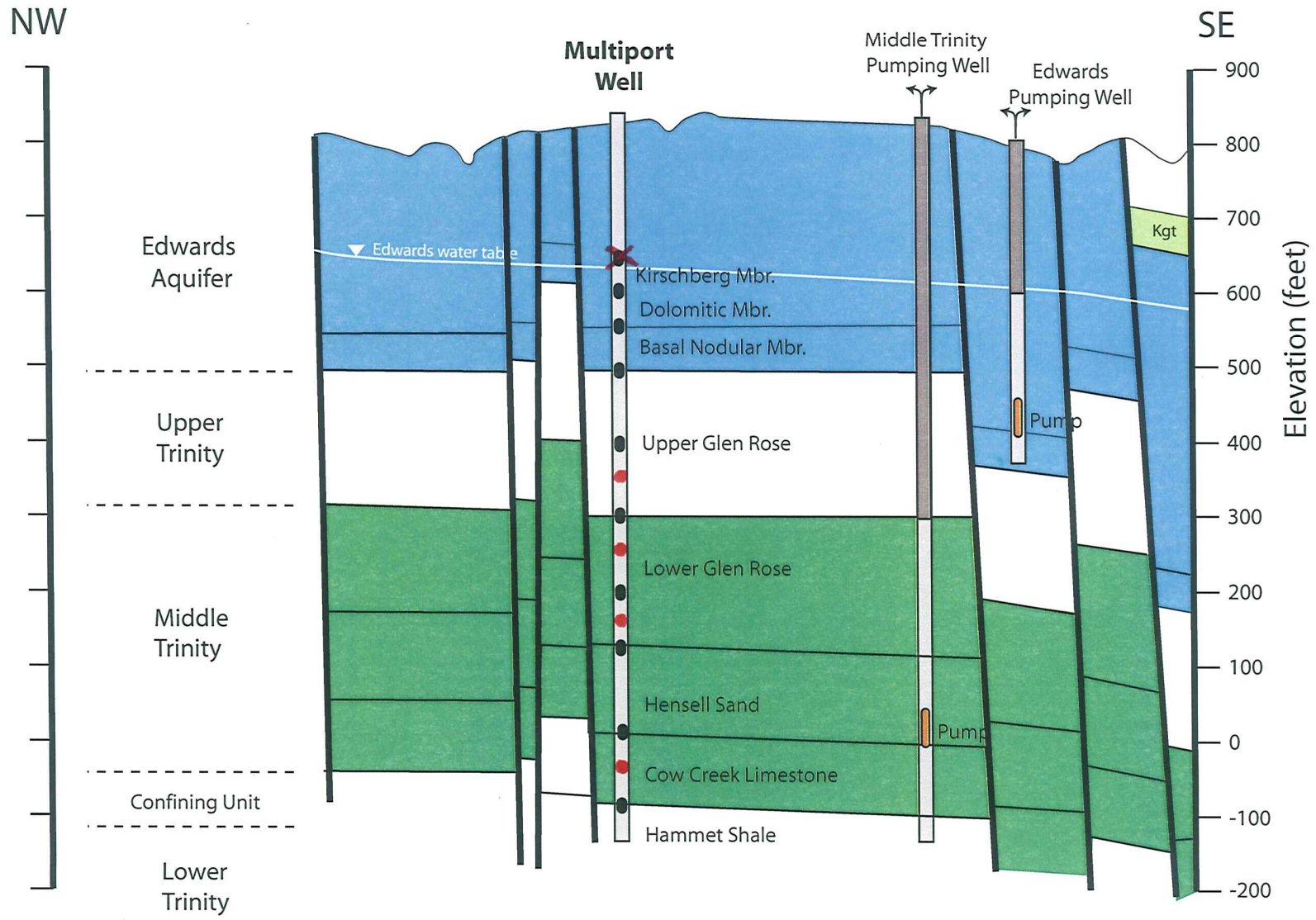
CONCLUSIONS: Spring Flow

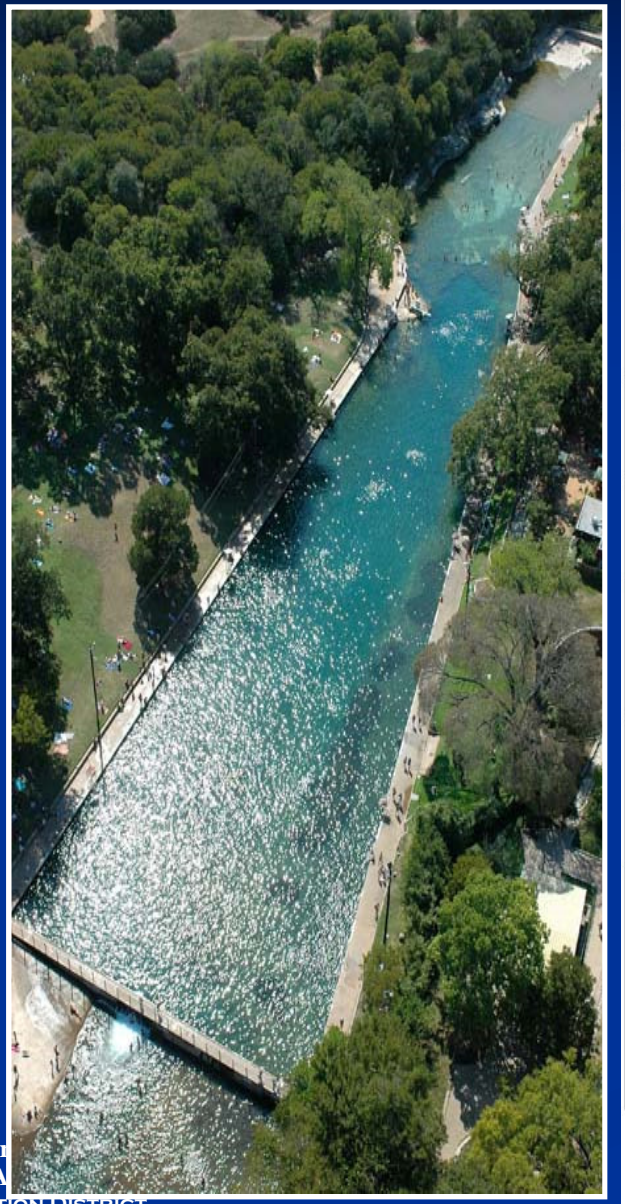
- For each 1 cfs of groundwater pumped from the aquifer under 1950's drought conditions, discharge from Barton Springs will diminish by about the same rate.

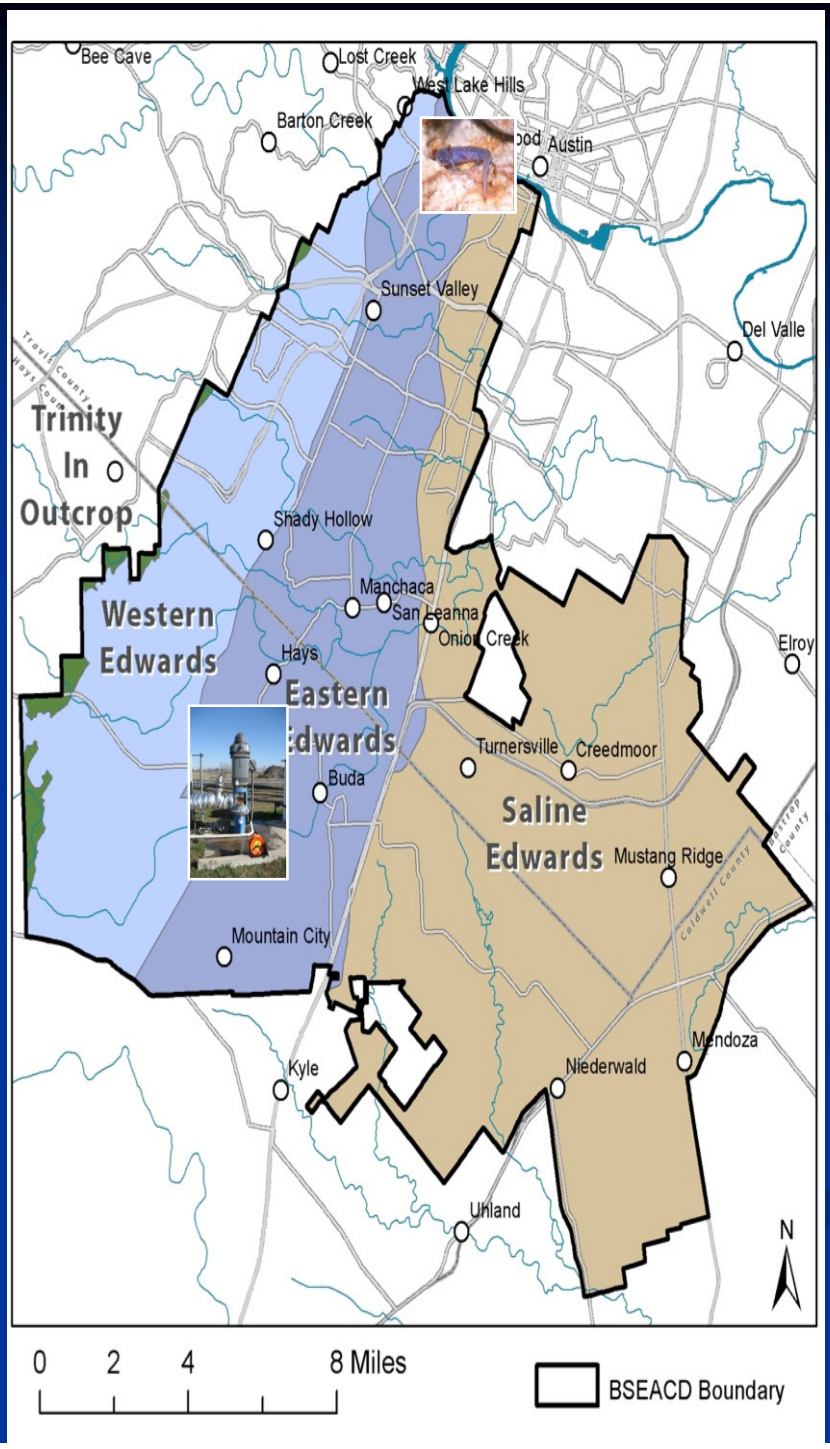
- At current permitted pumping levels (10 cfs), Barton Springs discharge is predicted to decrease to about 1 cfs on a monthly average, although may temporarily cease at times.

Schematic Cross Section Illustrating the Multiport Well System
Barton Springs Segment of the Edwards Aquifer, Hays County, Texas



Barton Springs and the Edwards Aquifer





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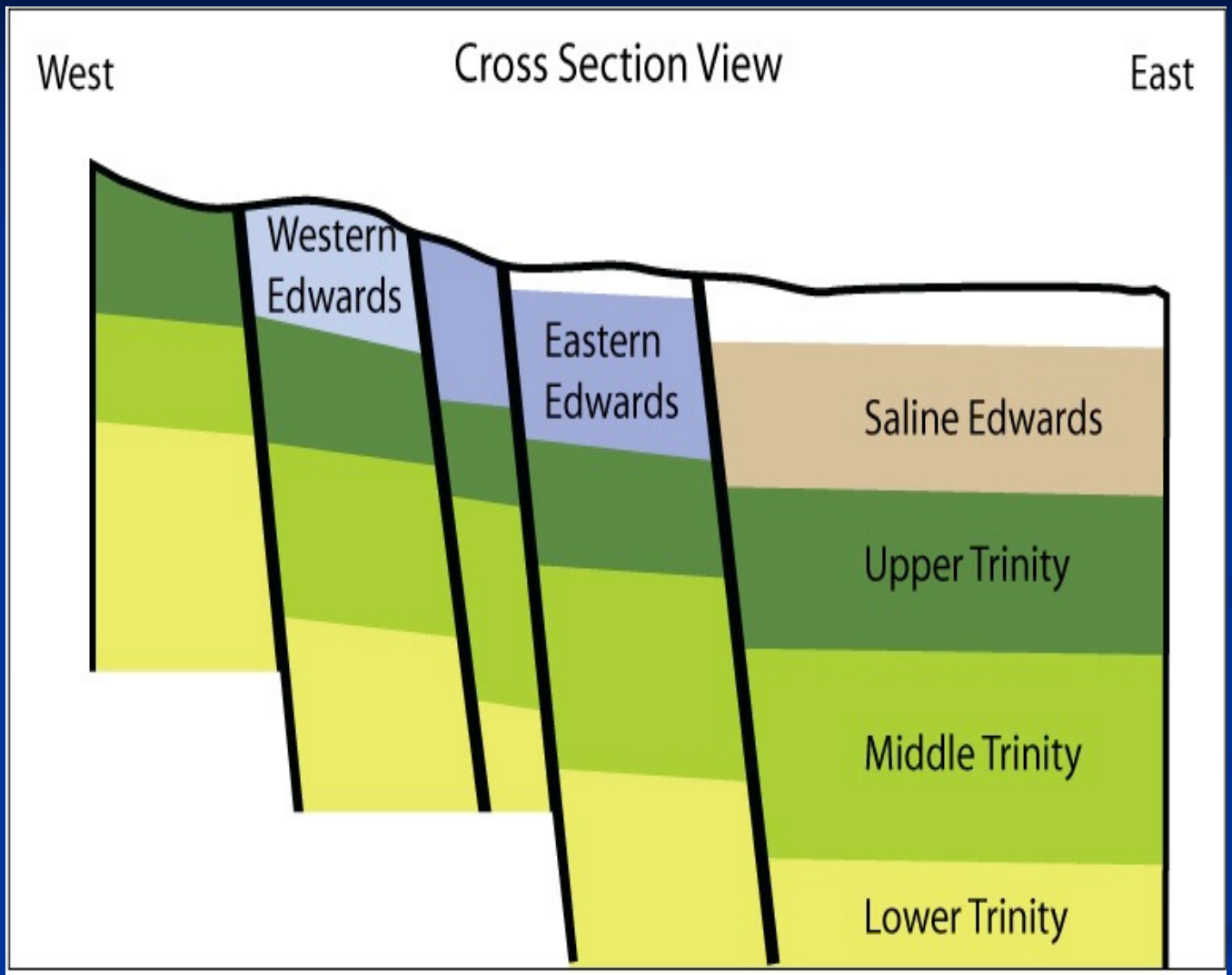
Management Zones



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