Edwards-Trinity Aquifer Water Budget Analysis

Presented to

Hill Country Geoscientists

By

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Southwest Research Institute®

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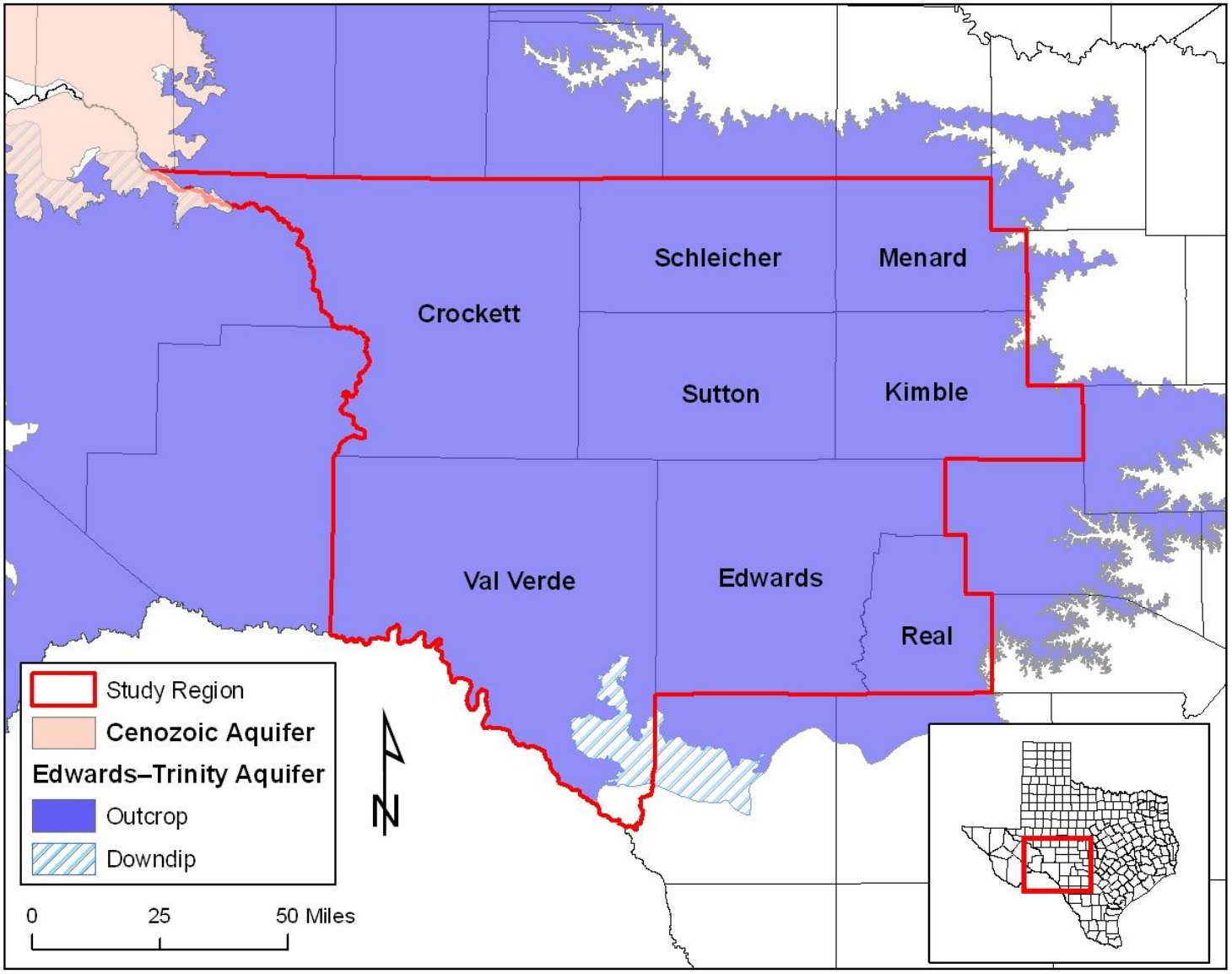
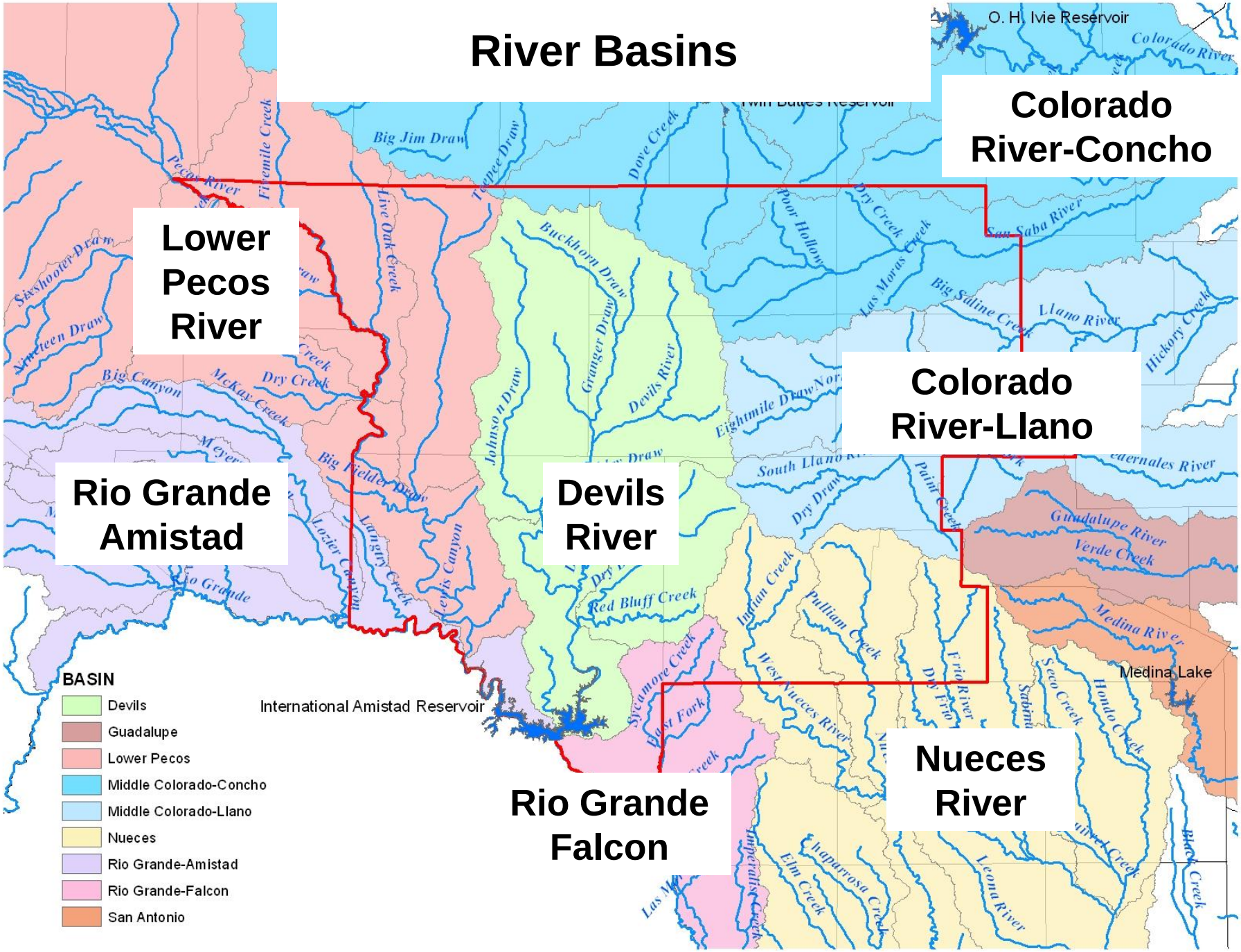
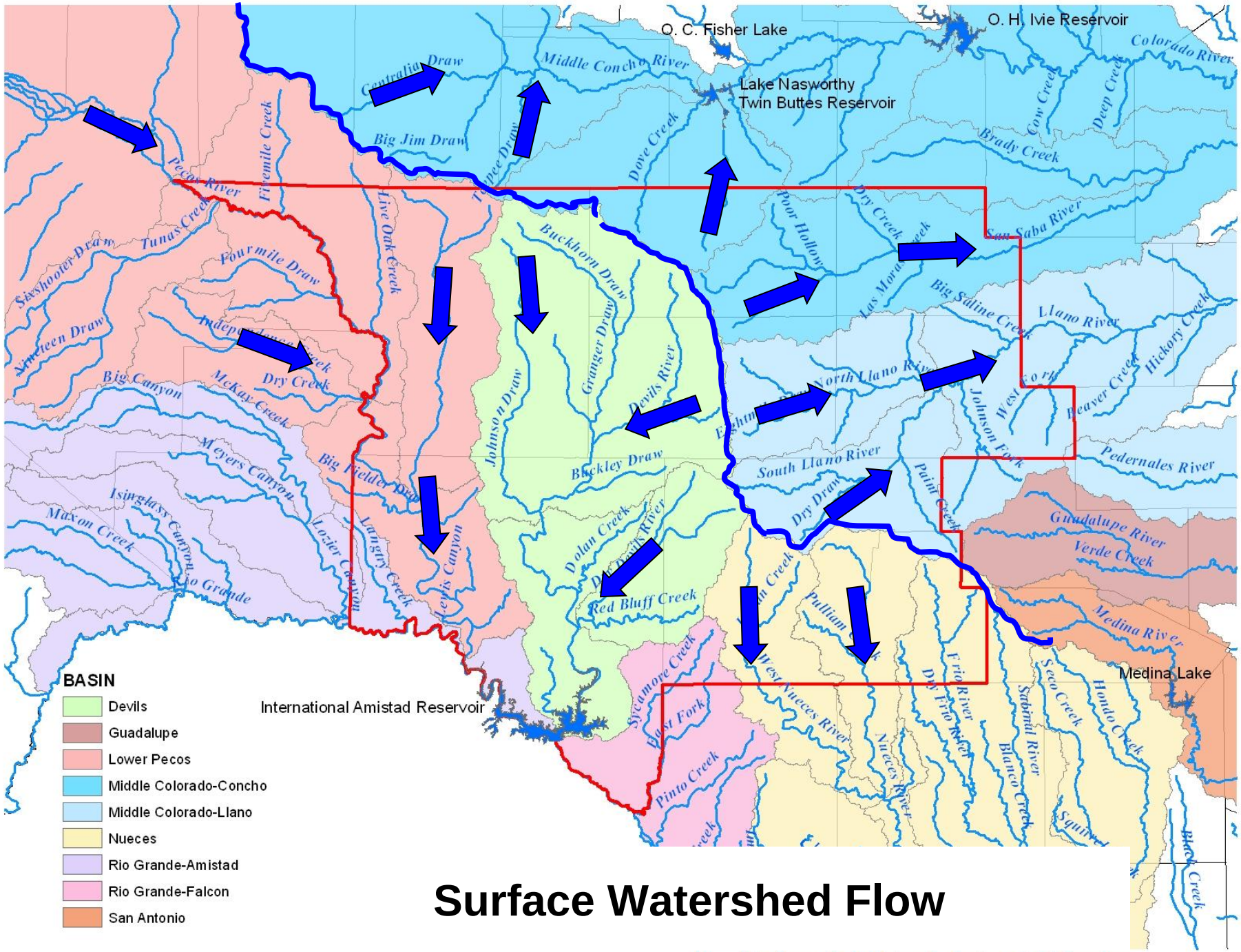
Edwards-Trinity Aquifer Water Budget Analysis

- Motivated by HB 1763 requirement for Desired Future Conditions (DFC) determination in September 2010
- The Texas Water Development Board (TWDB) uses Groundwater Availability Models (GAMs) to calculate the Managed Available Groundwater (MAG) that meets the DFCs
- The TWDB GAM for the Edwards-Trinity Aquifer is recognized as not sufficiently accurate, particularly in the western Edwards-Trinity Aquifer
- The TWDB allows for alternative analysis to be used in lieu of a GAM for those cases where the GAM is lacking
- Six Groundwater Conservation Districts and the City of Del Rio retained Southwest Research Institute to perform a water budget analysis to determine their DFCs
- Independent analysis from the water budget analysis will provide increased confidence in DFCs that are ultimately identified for the eight counties

Project Study Area



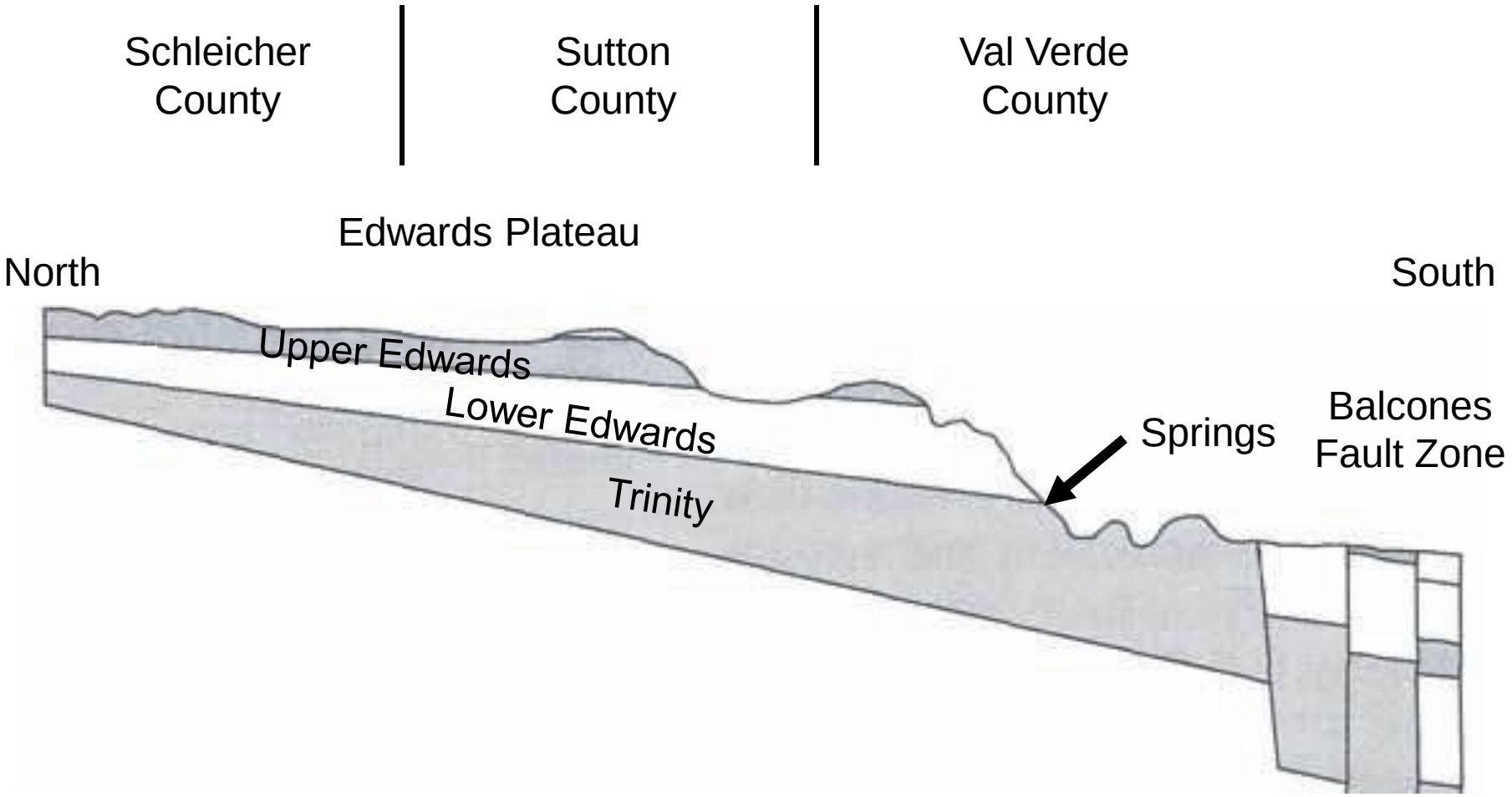

River Basins
Colorado River-Concho
Lower Pecos River
Colorado River-Llano
Rio Grande Amistad
Devils River
Rio Grande Falcon
Nueces River
O. H. Ivie Reservoir
International Amistad Reservoir
Medina Lake
BASIN
Devils
Guadalupe
Lower Pecos
Middle Colorado-Concho
Middle Colorado-Llano
Nueces
Rio Grande-Amistad
Rio Grande-Falcon
San Antonio



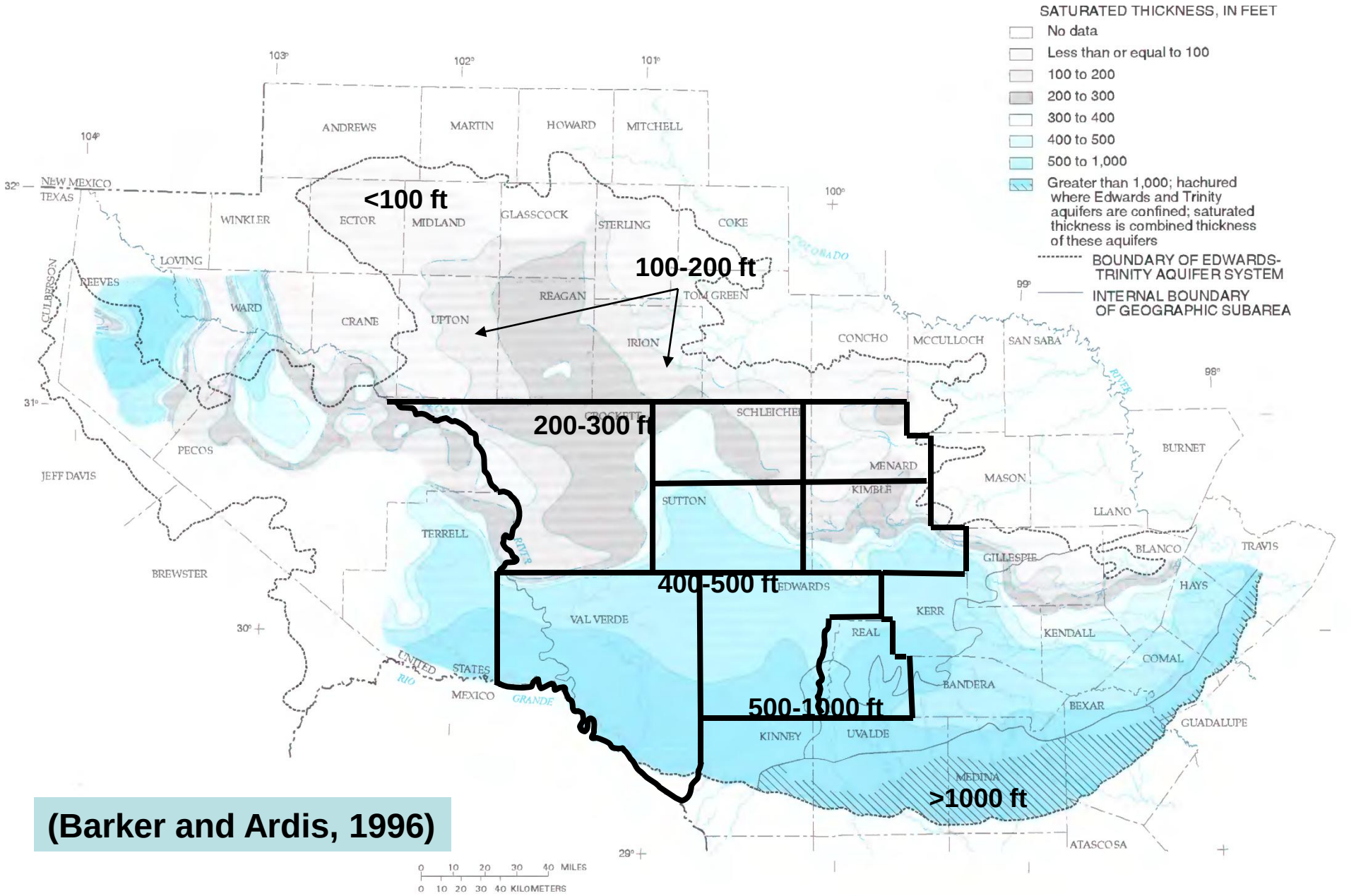
Surface Watershed Flow

Major Springs

Spring Flow in the Southern Edwards Plateau

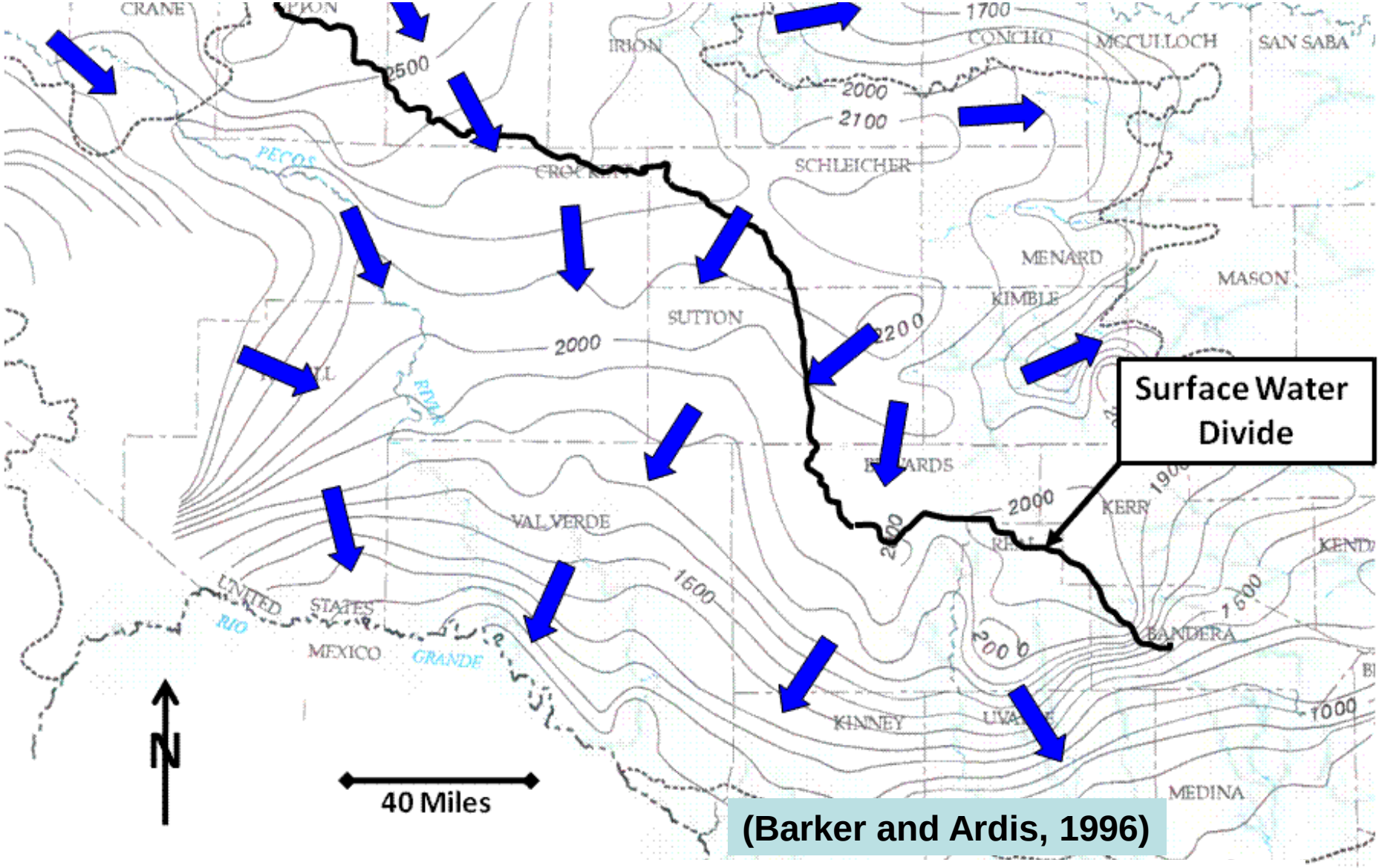


Saturated Thickness of Edwards-Trinity Aquifer



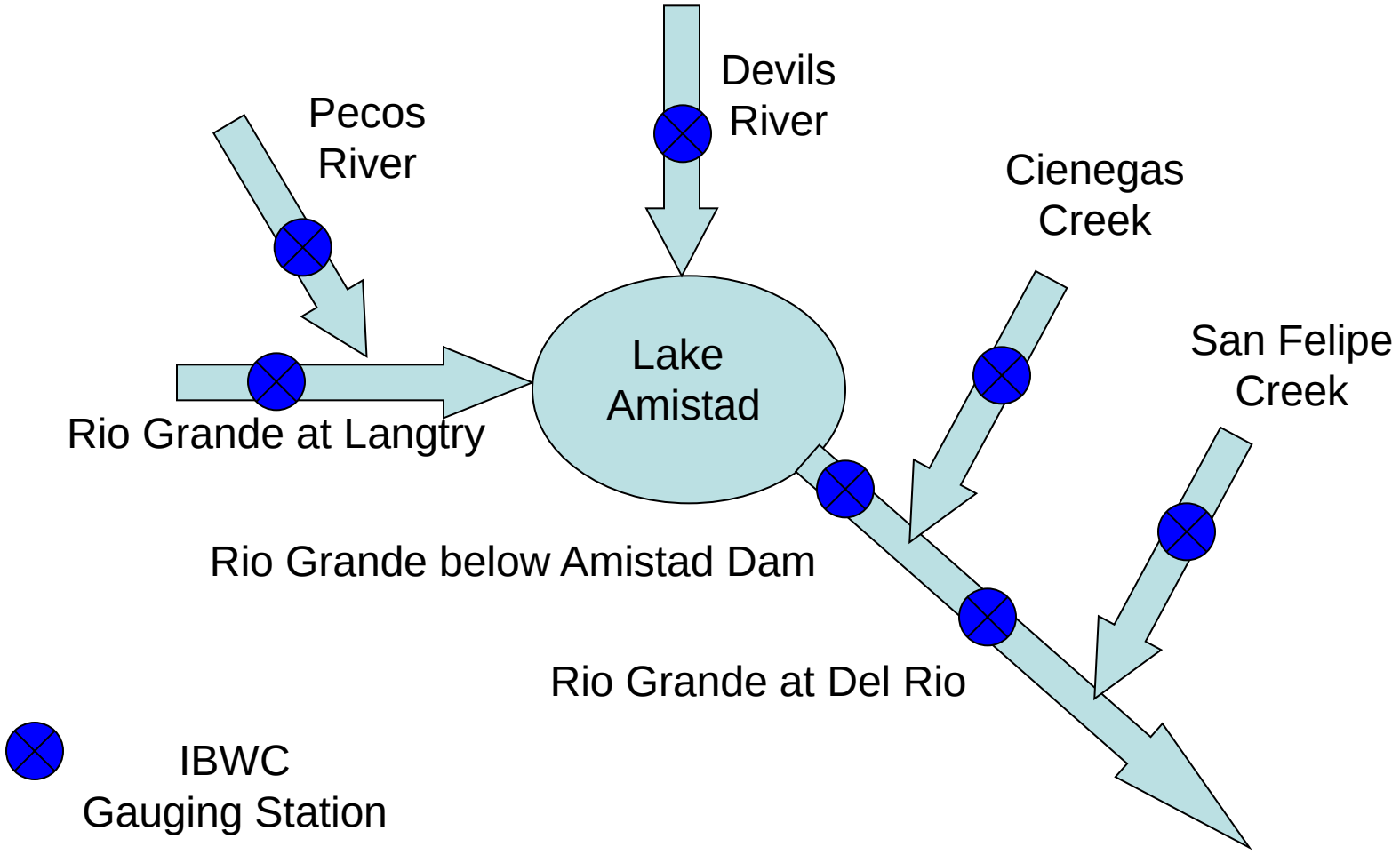
(Barker and Ardis, 1996)

Potentiometric Surface of Edwards-Trinity Aquifer

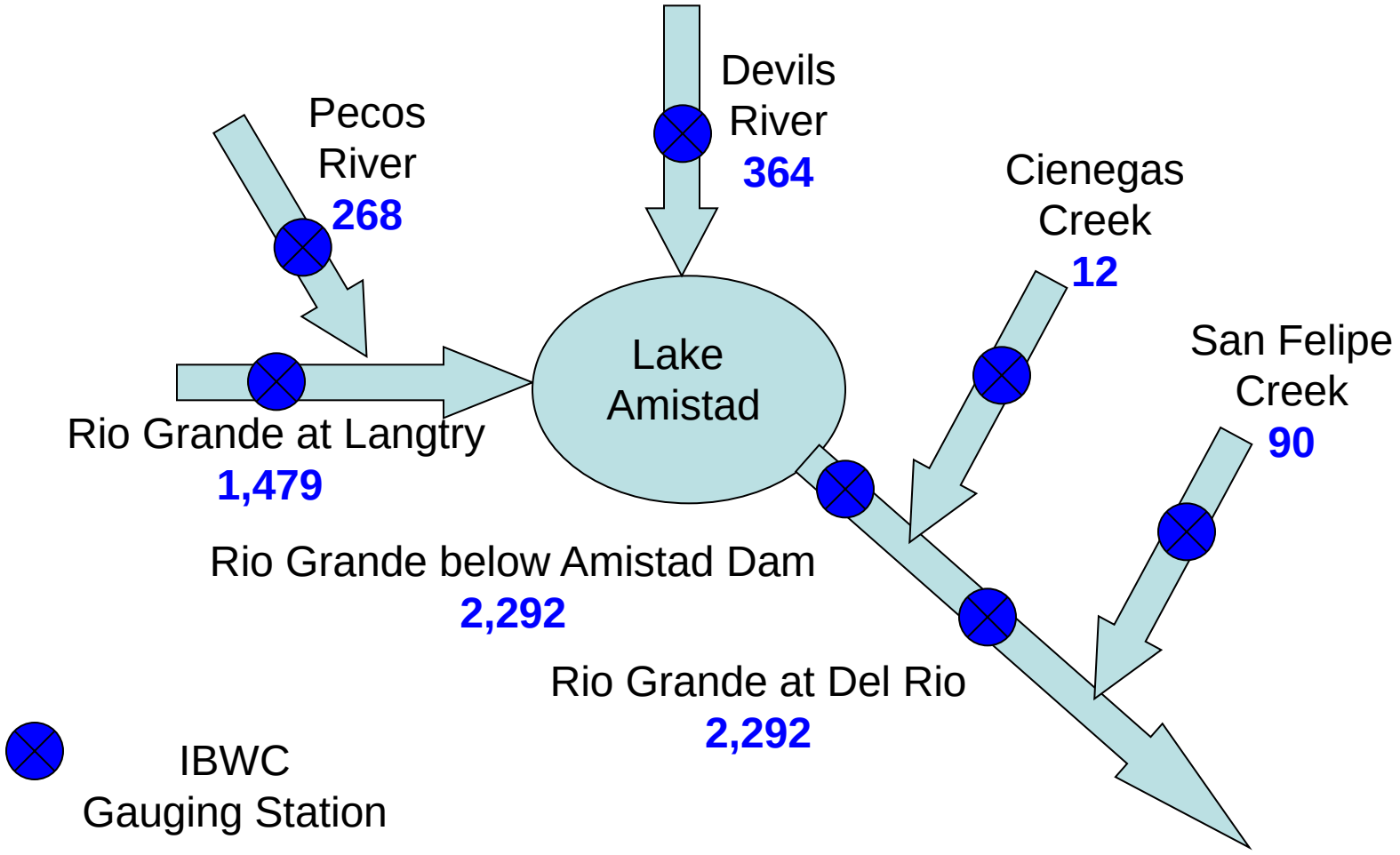


Groundwater Catchment ≠ Surface Watershed

Rio Grande Water Budget in Val Verde County



Rio Grande Water Budget in Val Verde County (cfs)



Water Budget Analysis in Val Verde County (cfs)

Rio Grande Water Balance at Lake Amistad

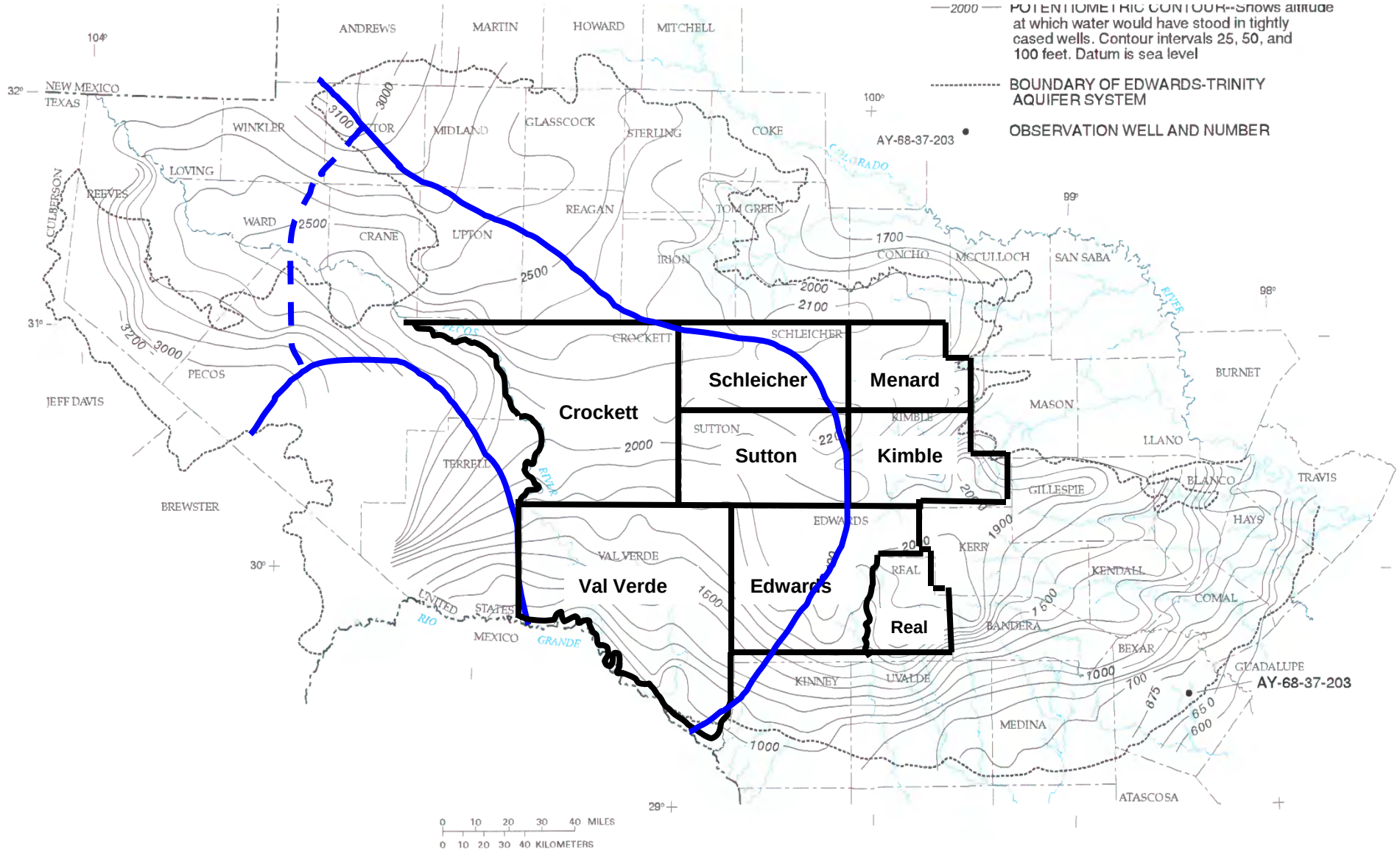
Rio Grande Upstream	1,479
Pecos River	268
Devils River	364
Cienegas Creek	12
Total	2,123
Goodenough Spring	142
Total	2,265
Rio Grande Downstream	2,292

Groundwater Discharge Val Verde County

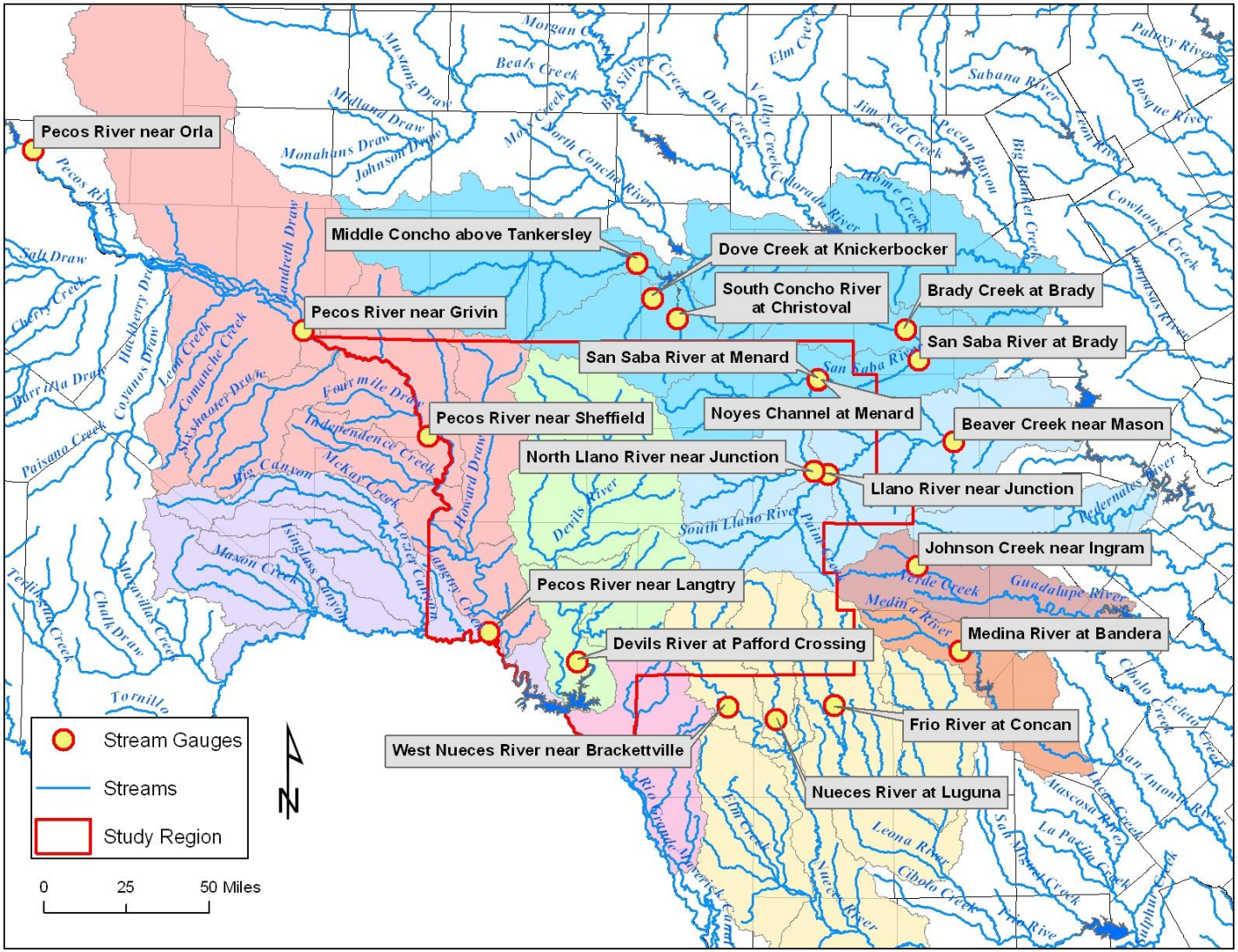
Pecos River	268*
Devils River	364*
Cienegas Creek	12
Goodenough Spring	142
San Felipe Springs	90
Total	876

*** Not corrected for storm flow**

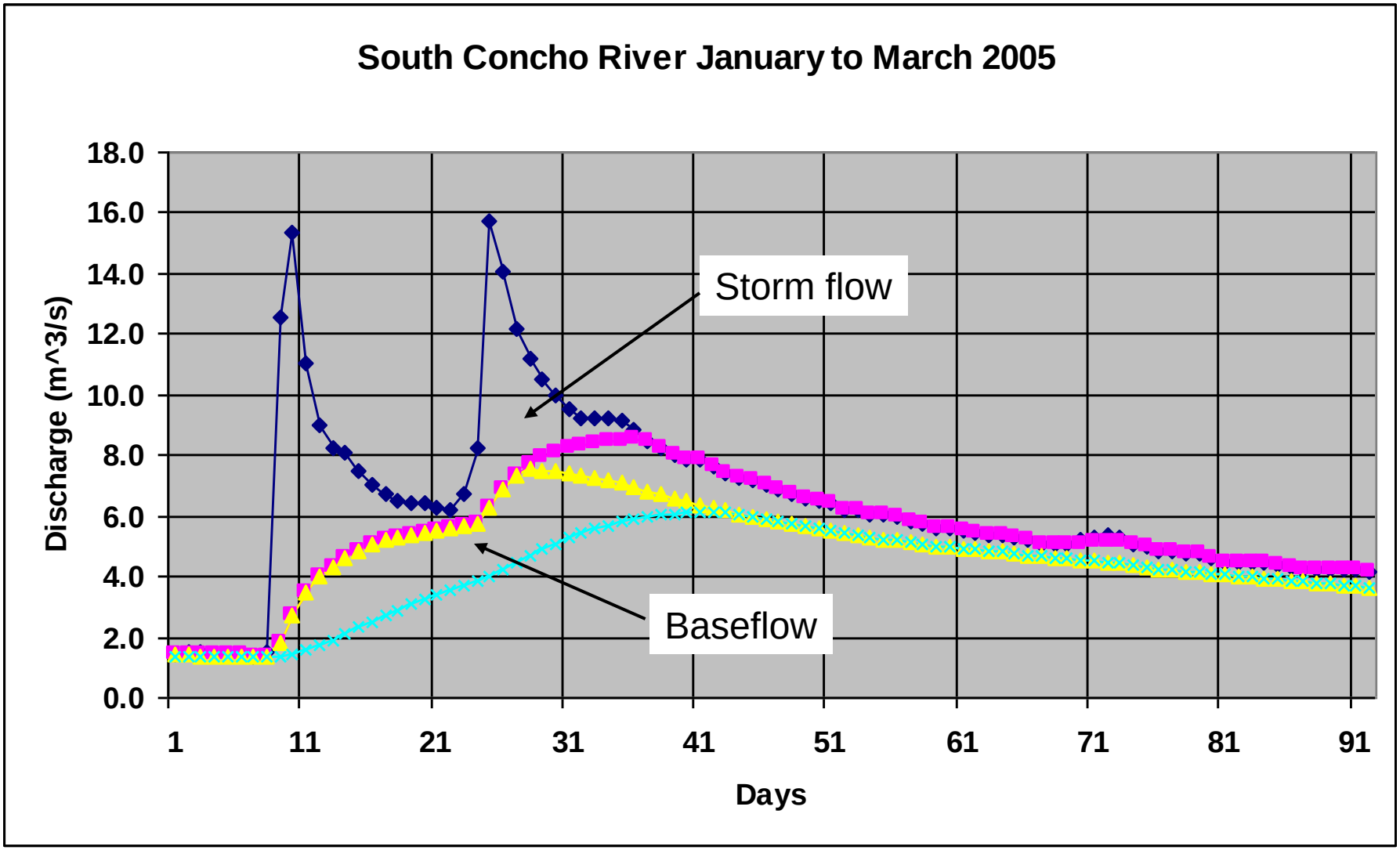
Approximate Area of Groundwater Catchment Area that Discharges in Val Verde County



River Gauging Stations



Recharge rate is calculated as baseflow component of river discharge



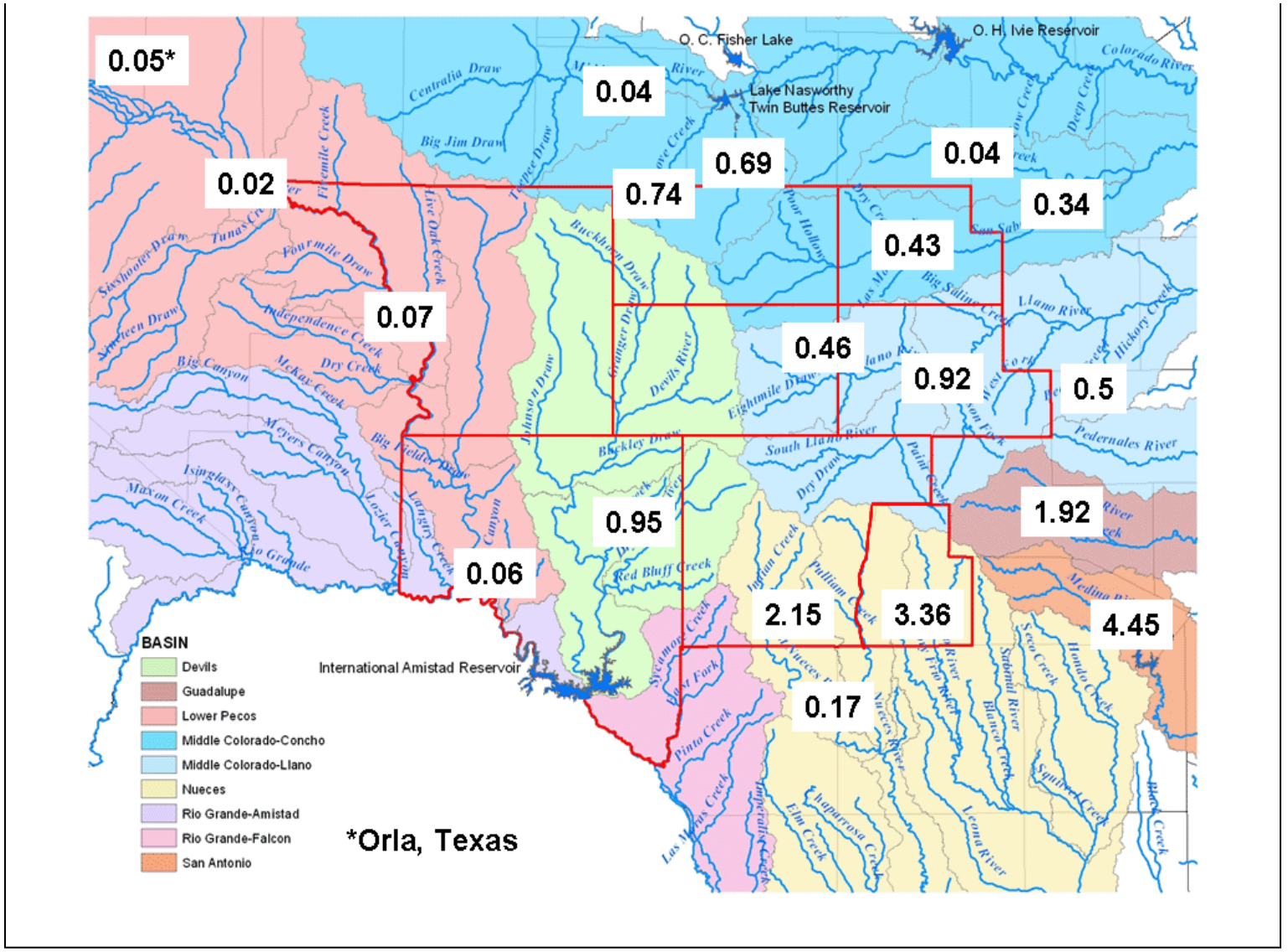
Recharge from River Discharge

River	County	Drainage Area (acre)	Gauging Start Date	Recharge (inch/year)	Baseflow Fraction	Adjusted Recharge (inch/year)
Nueces River at Laguna	Uvalde	471,680	10/1923	3.03	0.71	2.15
West Nueces River near Brackettville	Kinney	444,160	9/1939	0.67	0.25	0.17
Frio River at Concan	Uvalde	284,960	10/1923	4.45	0.75	3.36
Medina River at Bandera	Bandera	209,920	10/1982	6.77	0.68	4.54
Johnson Creek at Ingram	Kerr	72,960	10/1941	3.10	0.62	1.92
Brady Creek at Brady	McCulloch	376,320	6/1939	0.15	0.29	0.04
San Saba River Near Brady	McCulloch	1,045,120	7/1979	0.59	0.58	0.34
San Saba River at Menard	Menard	721,920	10/1915	0.72	0.48	0.35
Beaver Creek near Mason	Mason	137,600	8/1963	1.20	0.46	0.50
North Llano River at Junction	Kimble	584,960	10/1915	1.00	0.64	0.46
Llano River at Junction	Kimble	1,183,360	10/1915	1.45	0.42	0.92
South Concho River at Christoval	Tom Green	226,560	3/1930	1.15	0.60	0.69
Dove Creek at Knickerbocker	Tom Green	139,520	10/1960	0.98	0.76	0.74
Middle Concho River at Tankersley	Irion	714,240	4/1961	0.17	0.21	0.04

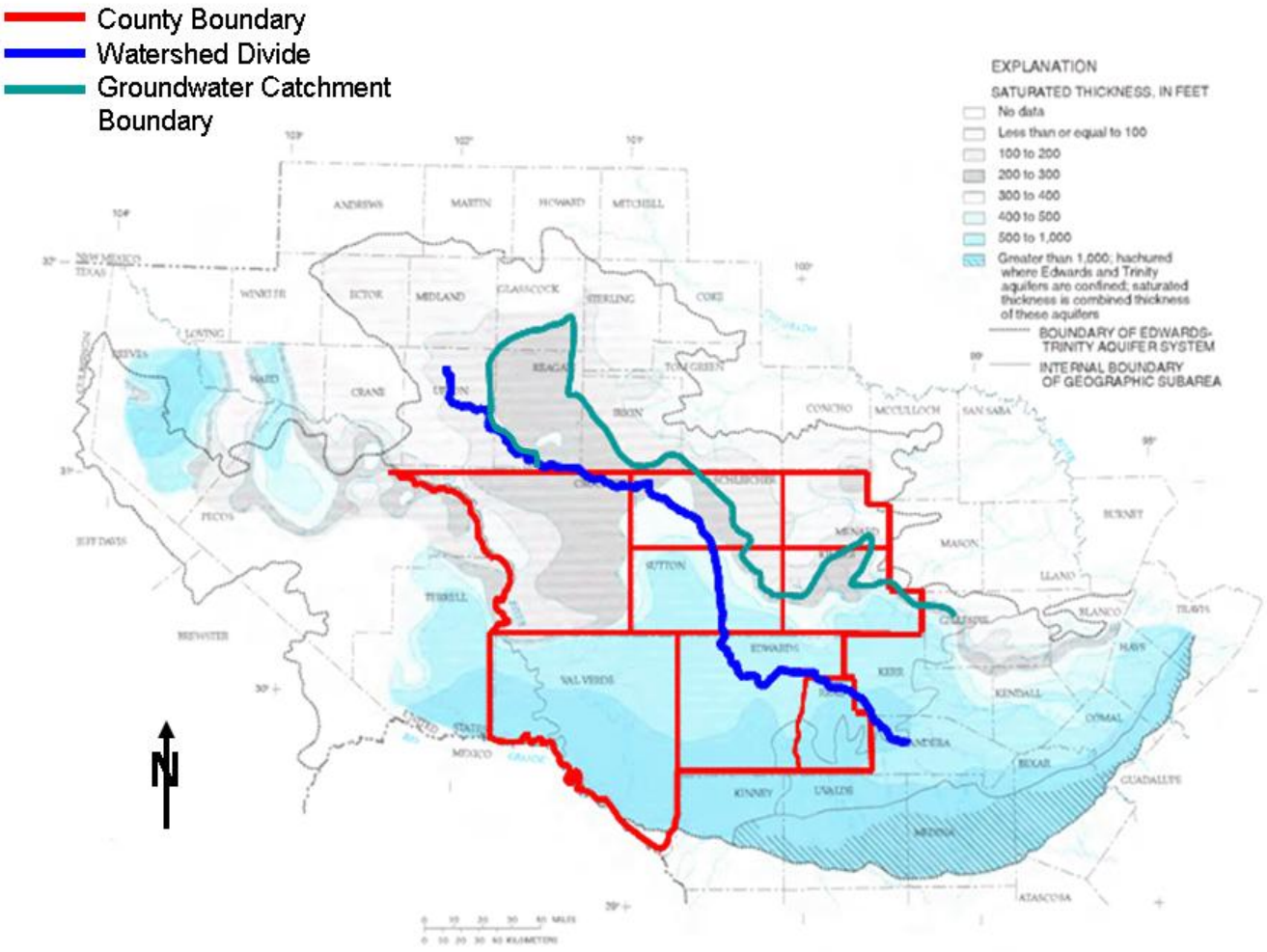
Recharge from River Discharge (Continued)

River	County	Drainage Area (acre)	Gauging Start Date	Recharge (inch/year)	Baseflow Fraction	Adjusted Recharge (inch/year)
Devils River at Pafford Crossing	Val Verde	2,535,040	1/1960	1.25	0.76	0.95
Pecos River near Orla	Reeves	13,586,560	10/1937	0.08	0.66	0.05
Pecos River near Girvin	Pecos	18,918,400	9/1939	0.03	0.77	0.02
Pecos River near Sheffield	Pecos	20,384,000	18 years total	0.09	0.79	0.07
Pecos River near Langtry	Val Verde	28,352,000	1/1967	0.08	0.74	0.06

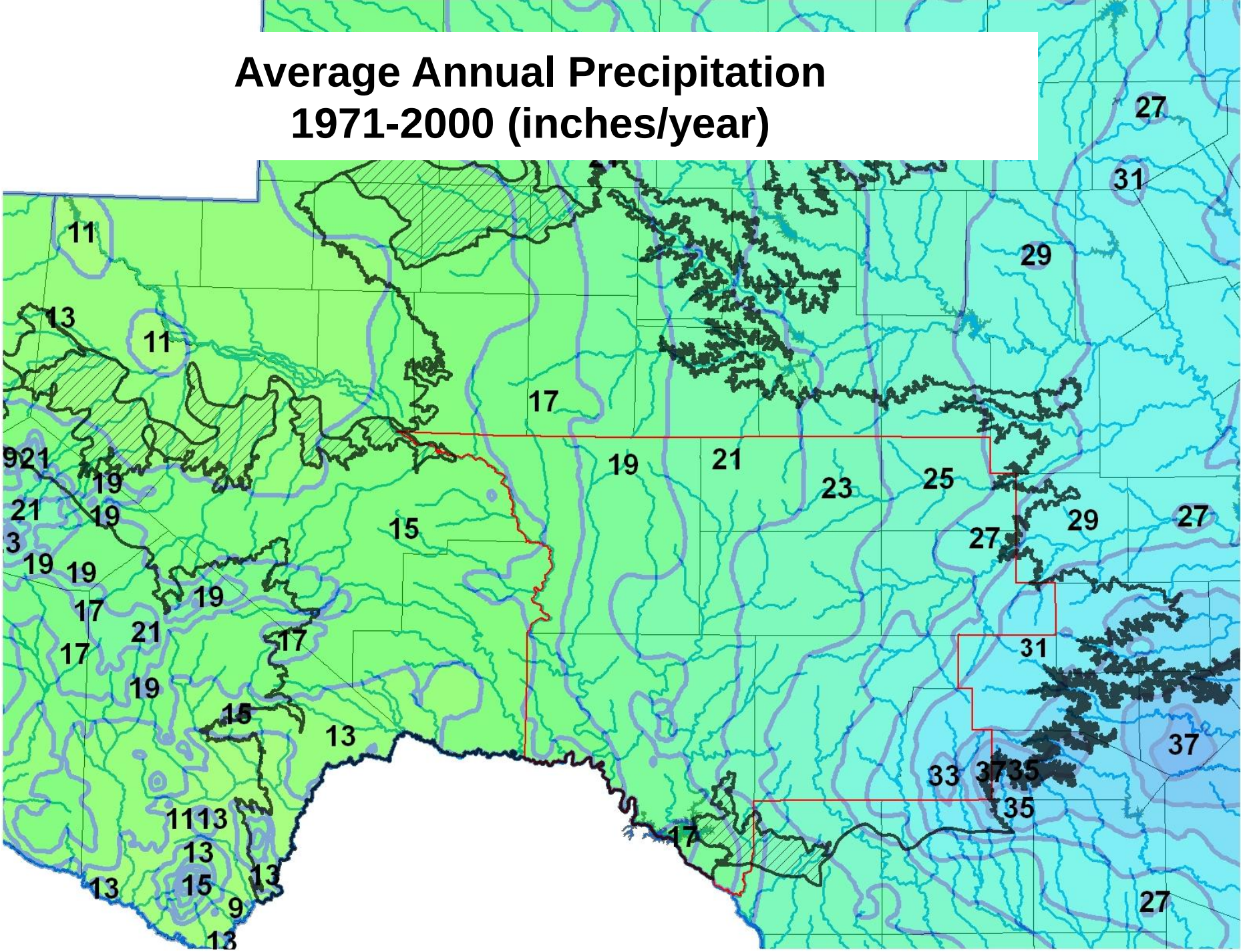
Recharge Rates Measured from River Discharge (inch/year)



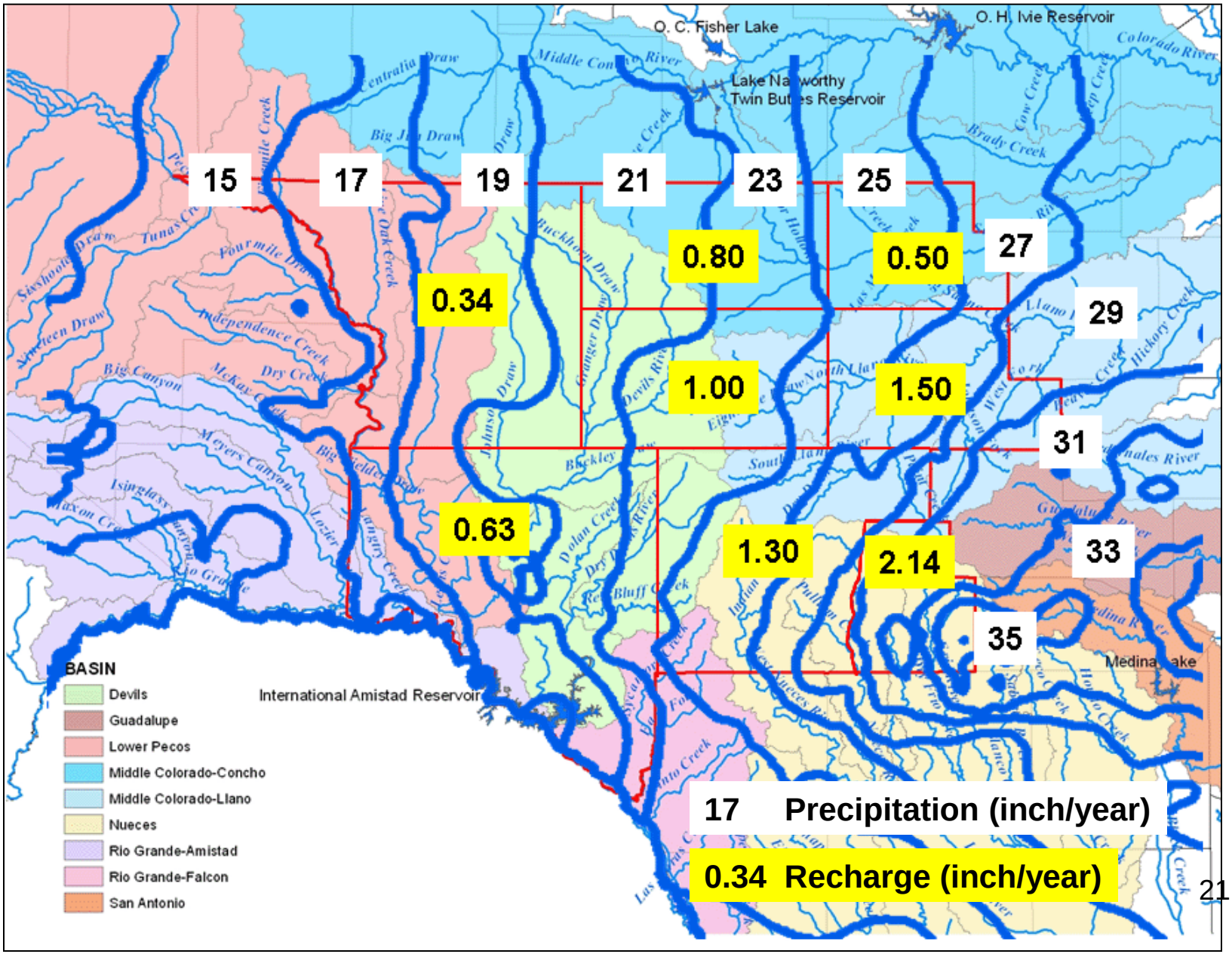
Extent of Groundwater Catchment



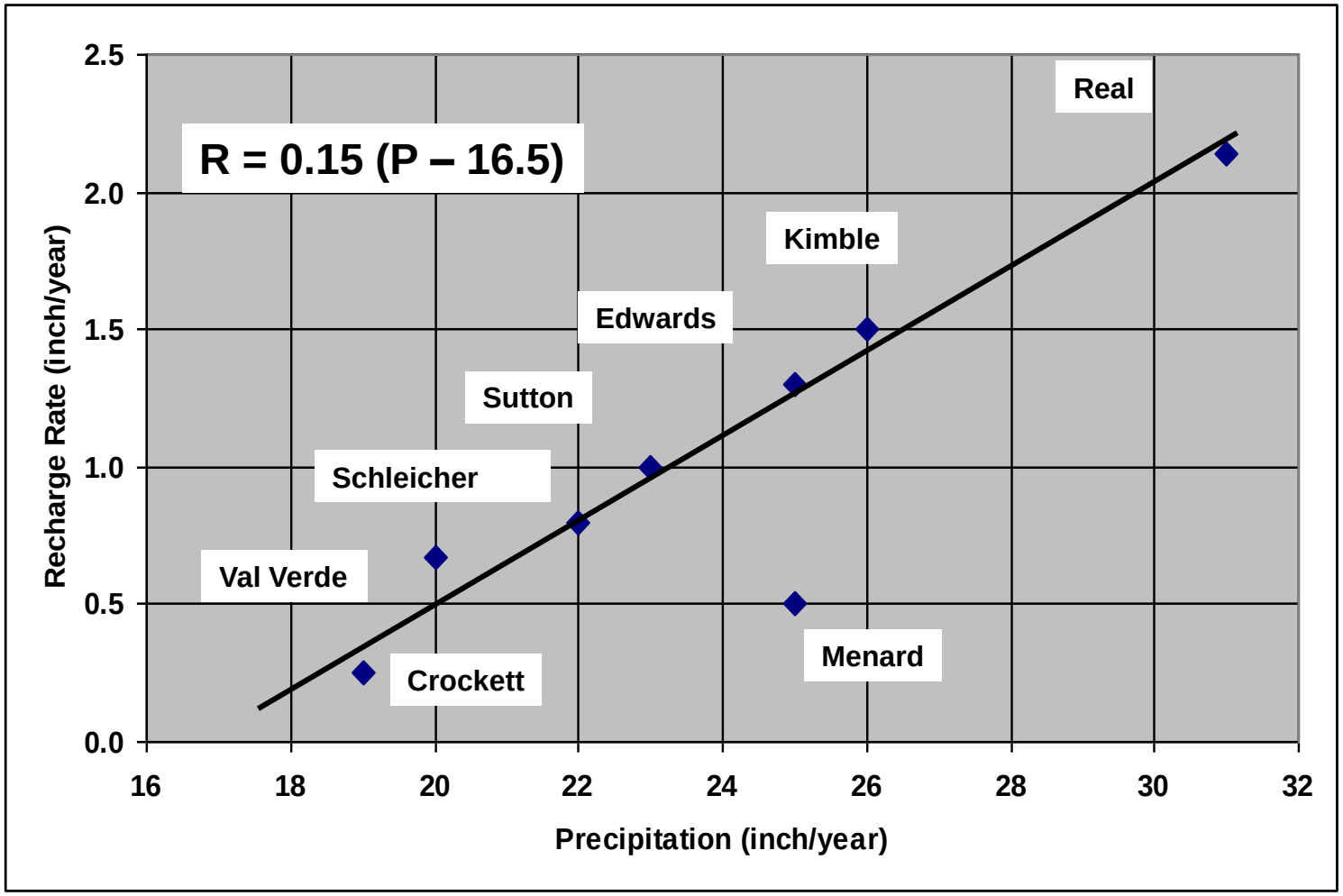
Average Annual Precipitation
1971-2000 (inches/year)



Summary of Recharge Rates (inch/year)



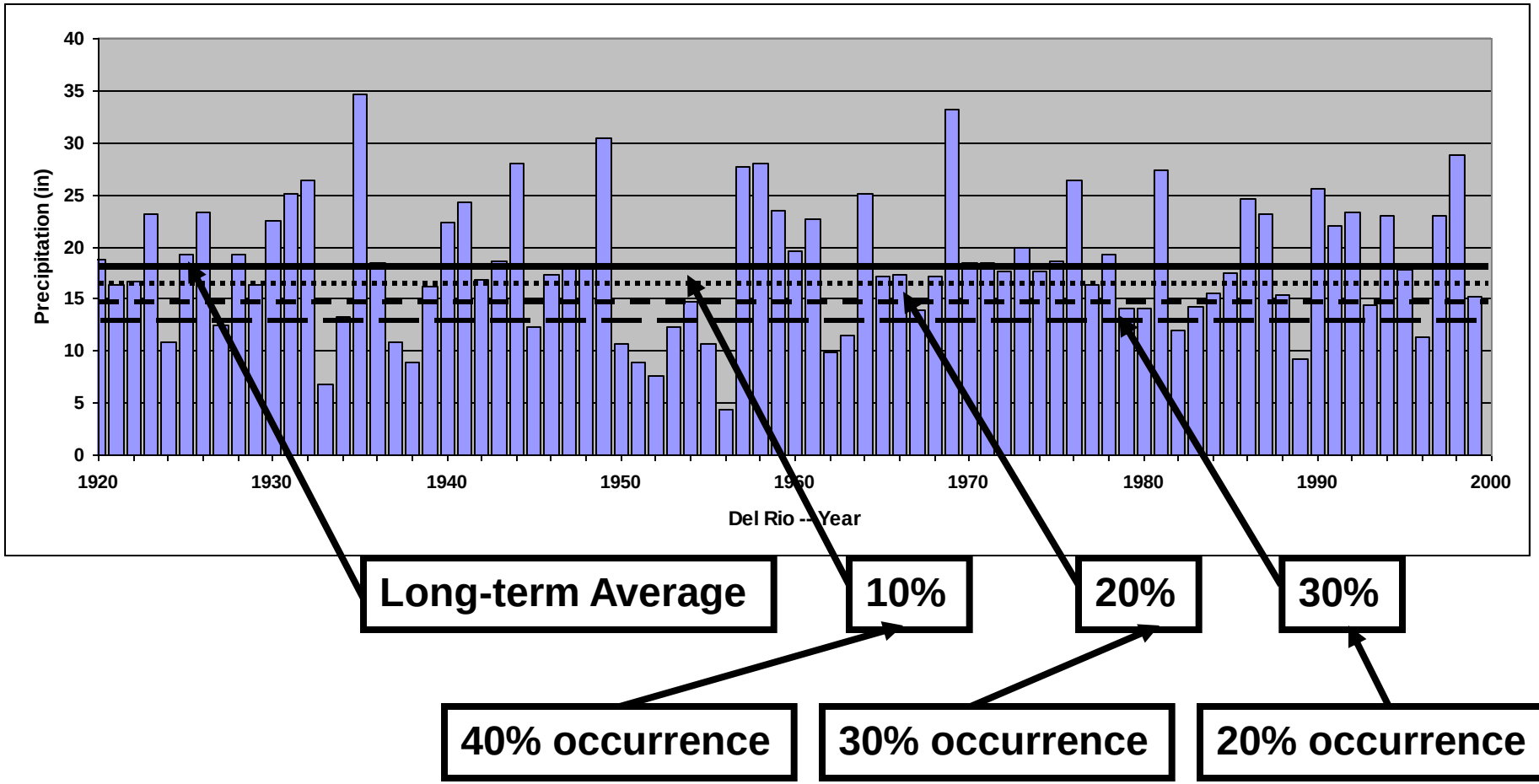
Relationship between Recharge and Precipitation



Relationships Among County Water Resources

	Significantly Impacted by Upgradient Counties	Moderately Impacted by Upgradient Counties	Significantly Impacts Down Gradient Counties	Moderately Impacts Down Gradient Counties
Crockett	Pecos, Reeves	-	Val Verde	Sutton
Edwards	Sutton	Kimble,Schleicher	Kinney	-
Kimble	Edwards, Sutton	Menard	Edwards, Mason	-
Menard	Schleicher	-	McCulloch	-
Real	-	Kerr, Kimble	Uvalde	Sutton
Schleicher	Menard	Tom Green	-	Tom Green
Sutton	Schleicher	-	Edwards, Val Verde	Crockett
Val Verde	Crockett, Pecos	Terrell, Reeves	-	-

Average Annual Precipitation
Del Rio (inch/year)



County Recharge and Managed Available Groundwater (MAG) (acre-feet/year)

	Crockett	Edwards	Kimble	Menard	Real	Schleicher	Sutton	Val Verde
Calculated Recharge	56,140	144,160	95,076	61,268	81,200	57,684	75,556	90,496
Predicted recharge at 90% precipitation	13,474	101,760	69,055	43,248	63,840	34,610	48,821	38,784
Predicted recharge at 80% precipitation	0	59,360	43,034	25,228	46,480	11,537	22,086	0
Predicted recharge at 70% precipitation	0	1,837	2,127	300	5,193	0	0	0
2004 GAM recharge	45,700	96,000	32,300	22,800	32,700	23,800	28,900	99,900
2007 Texas State Water Plan	25,460	8,669	23,965	19,000	5,737	16,164	20,775	49,607
2010 MAG (TWDB)	5,475	5,000	1,000	1,843	11,468	6,200	4,000	25,000

Key Findings

- Surface watersheds do not align with groundwater catchment areas
- Greater uncertainty in groundwater flow rates than in surface water flow rates
- Extent of groundwater catchment estimated
- Recharge rates estimated/calculated by this project are marginally different than previous estimates/calculations
  - Greatest uncertainty in Crockett and Val Verde counties (least precipitation)
  - Menard County underflow is significant
  - Real and Edwards counties benefit most from groundwater piracy
- Effect of variable precipitation is profound, especially in semi-arid regions
- Water resources of discrete geopolitical entities (i.e., counties, groundwater conservation districts) share commonalties
  - Geopolitical entity boundaries do not align with either surface watershed or groundwater catchment boundaries
  - Upstream entities actions can have profound impact on downstream entities

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