Advances in Understanding the Hydrogeology of the Edwards-Trinity Aquifer

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by

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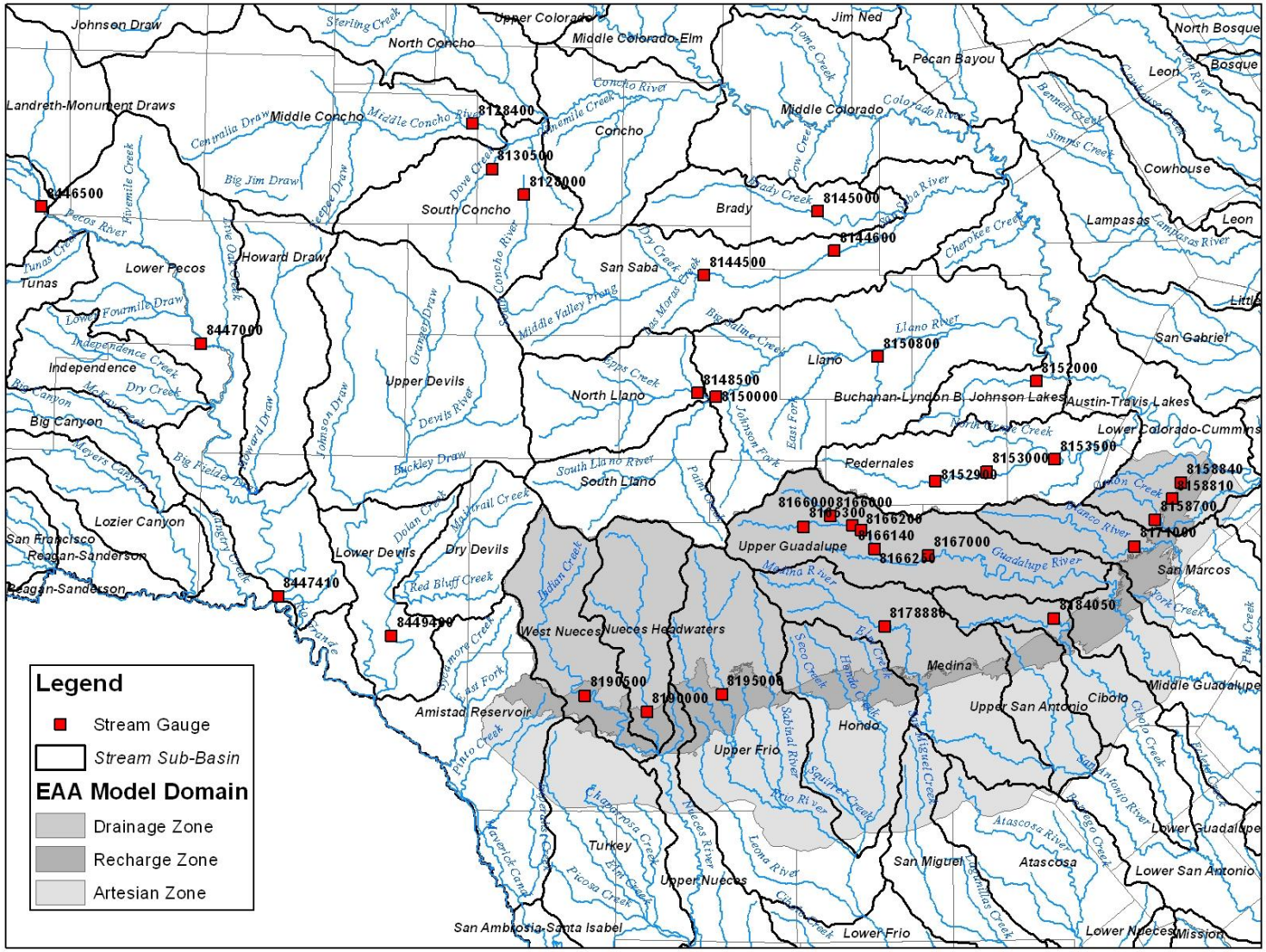
Background of Recharge Assessment

- Urban areas increasingly look to rural areas for increased water resources, some of these areas are in arid and semi-arid climates
- Imperative to correctly characterize the hydrogeology to be able to effectively manage water resources
- Correctly characterizing recharge is central to being able to effectively managing an aquifer
- Water resource management should be predicated on average drought conditions, not average conditions unless large-scale storage is available

Discharge measured at river gauging stations is used to estimate recharge



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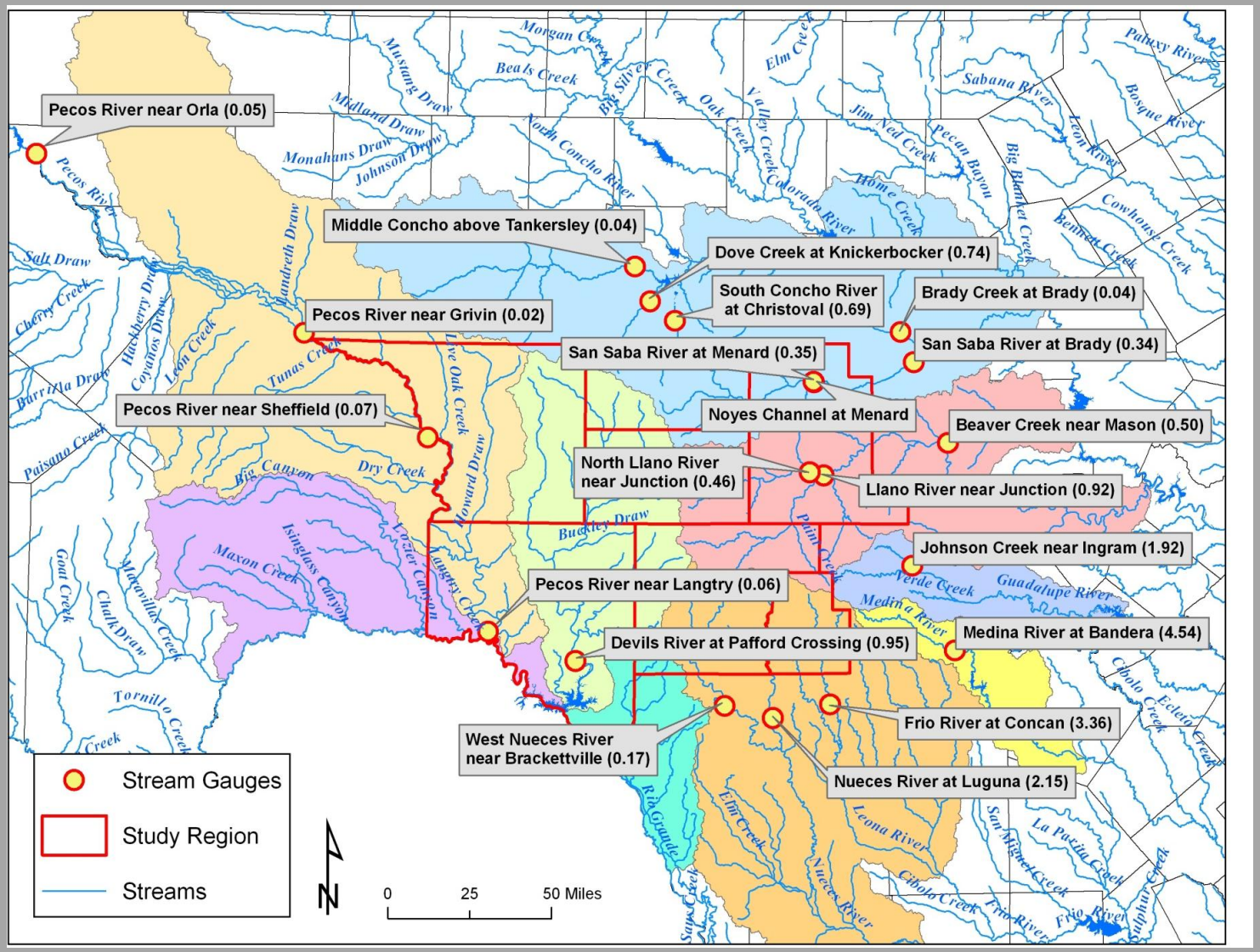
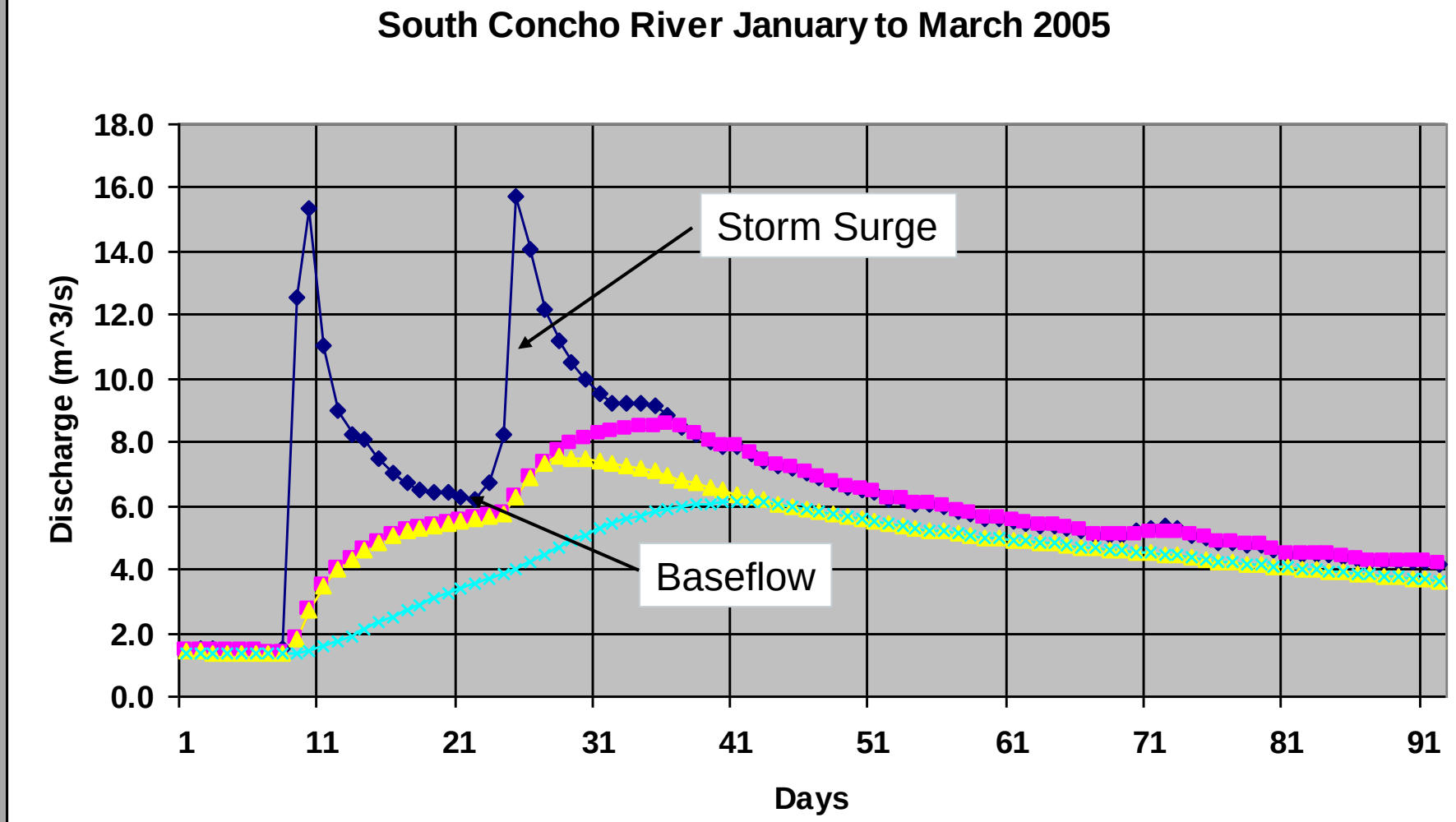
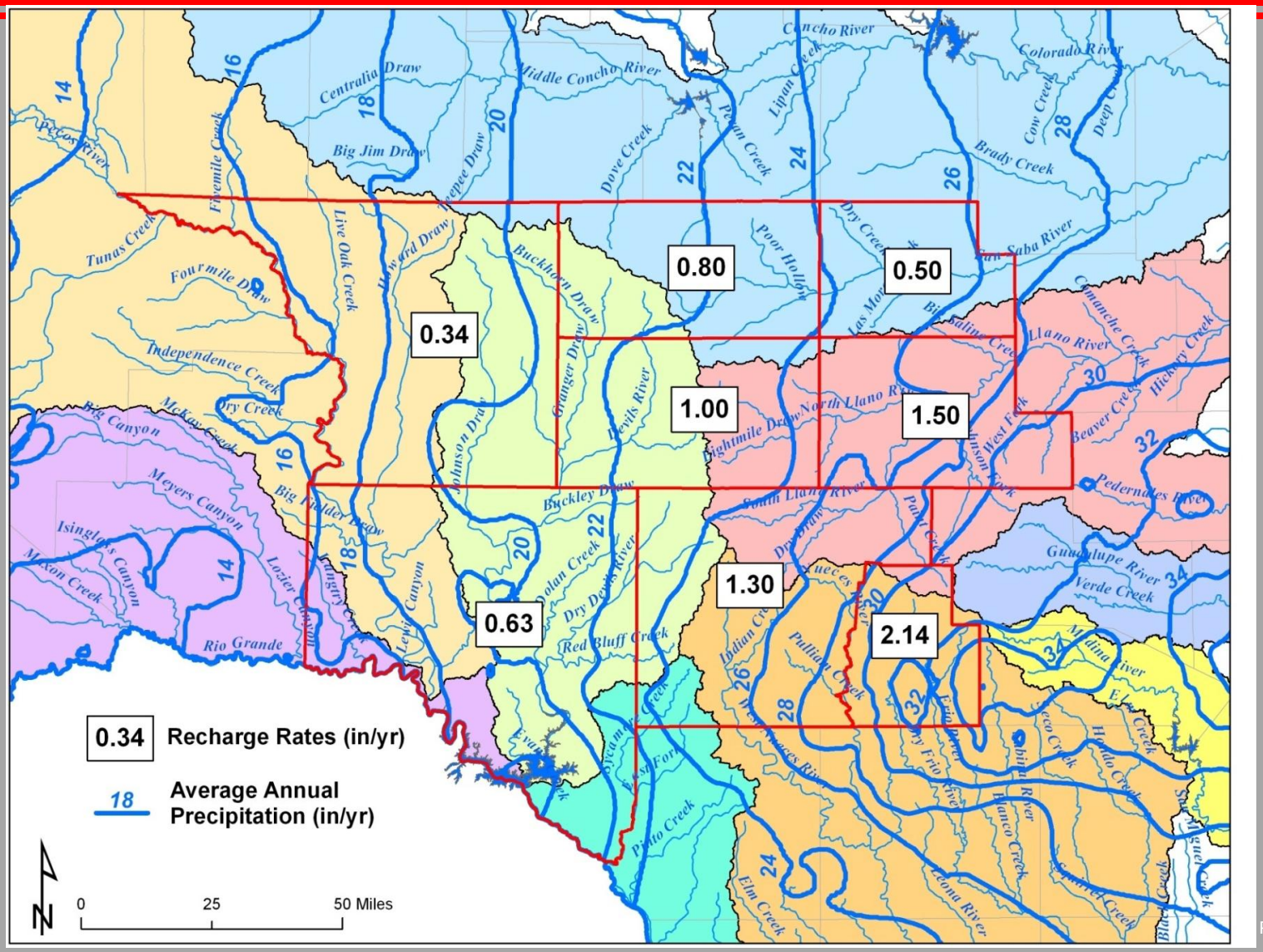


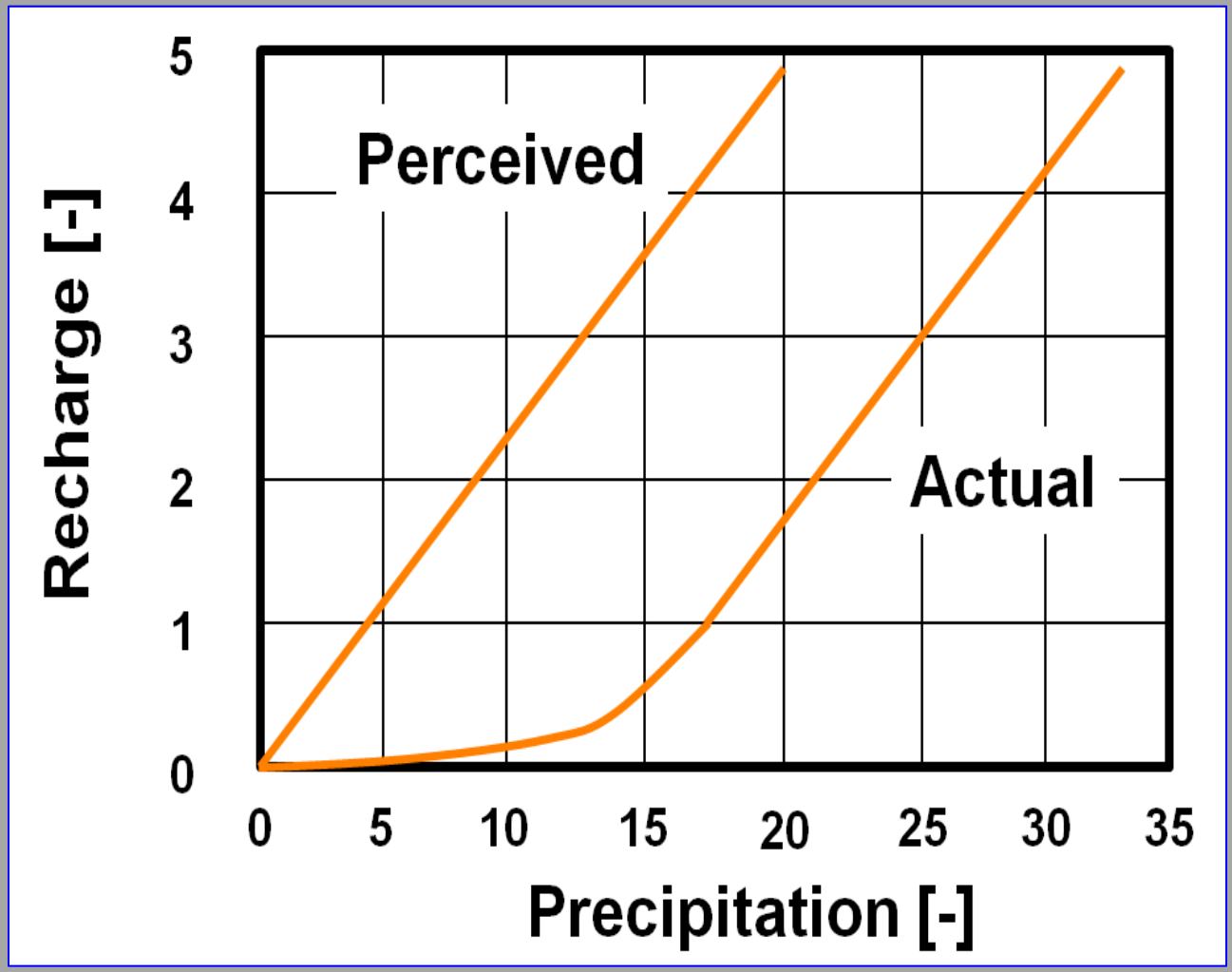
Recharge rate is calculated as baseflow component of river discharge



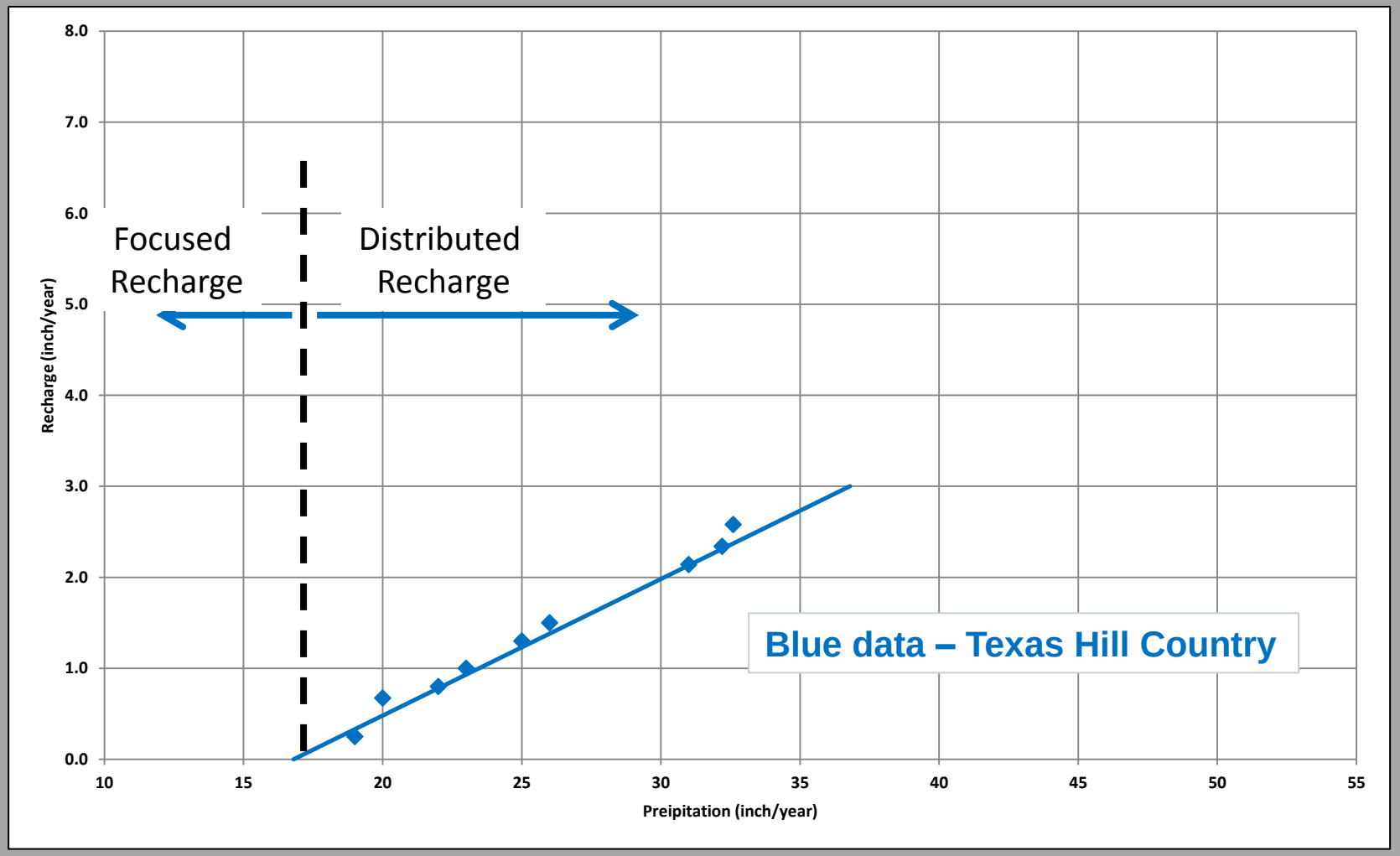
Recharge rates in study area corrected for actual groundwater catchment areas



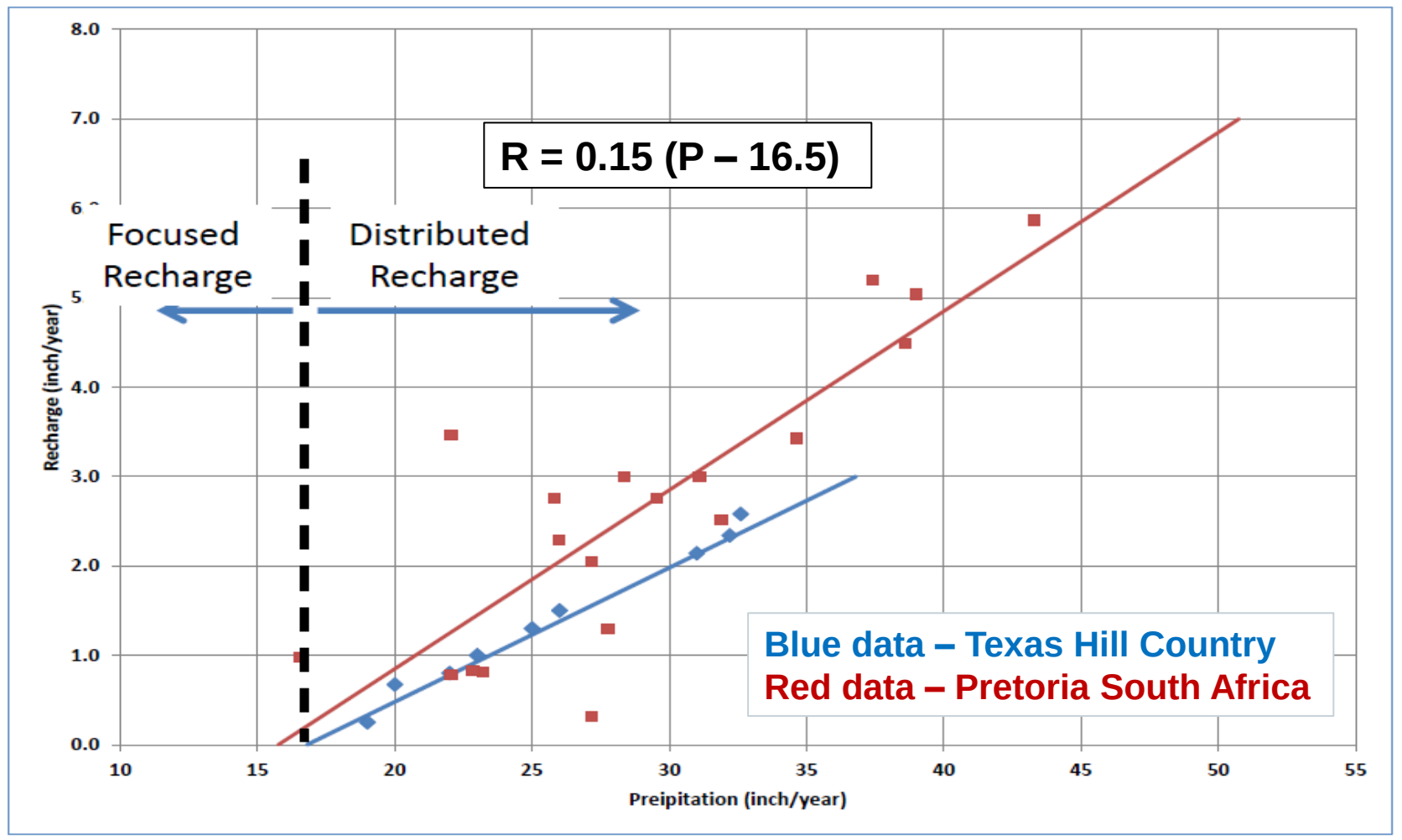
Average Recharge Decreases with Decrease in Average Precipitation and Becomes Negligible at Some Lower Threshold



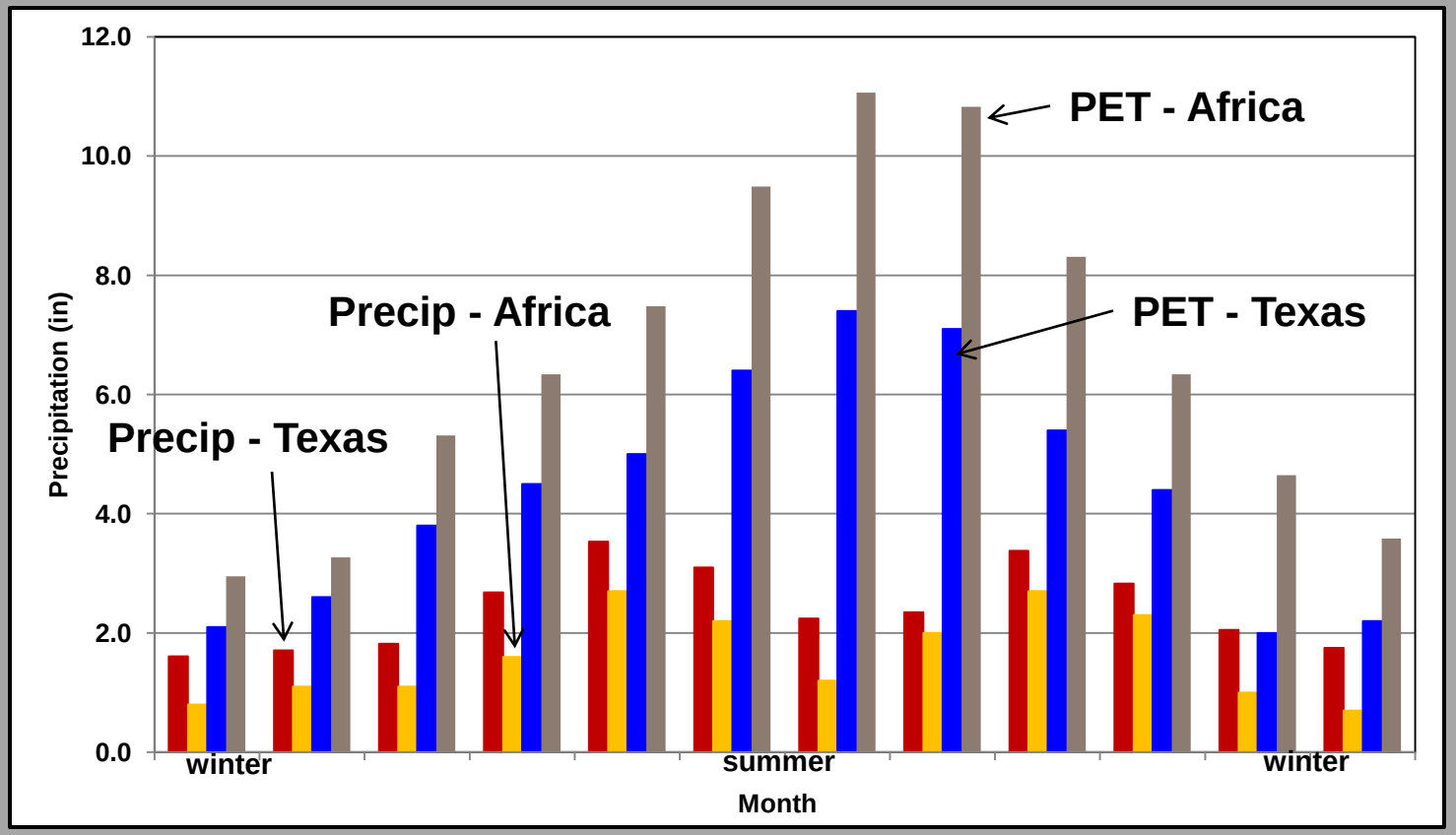
Recharge is Minimal when Precipitation is Less than 20 inch/year



Recharge is Minimal when Precipitation is Less than 20 inch/year Additional Supporting Data



Precipitation/Recharge Correlation Valid When PET > P



Potential Evapotranspiration

$$PET = 16\left(\frac{L}{12}\right)\left(\frac{N}{30}\right)\left(\frac{10T_a}{I}\right)^{\alpha}$$

PET is potential evapotranspiration

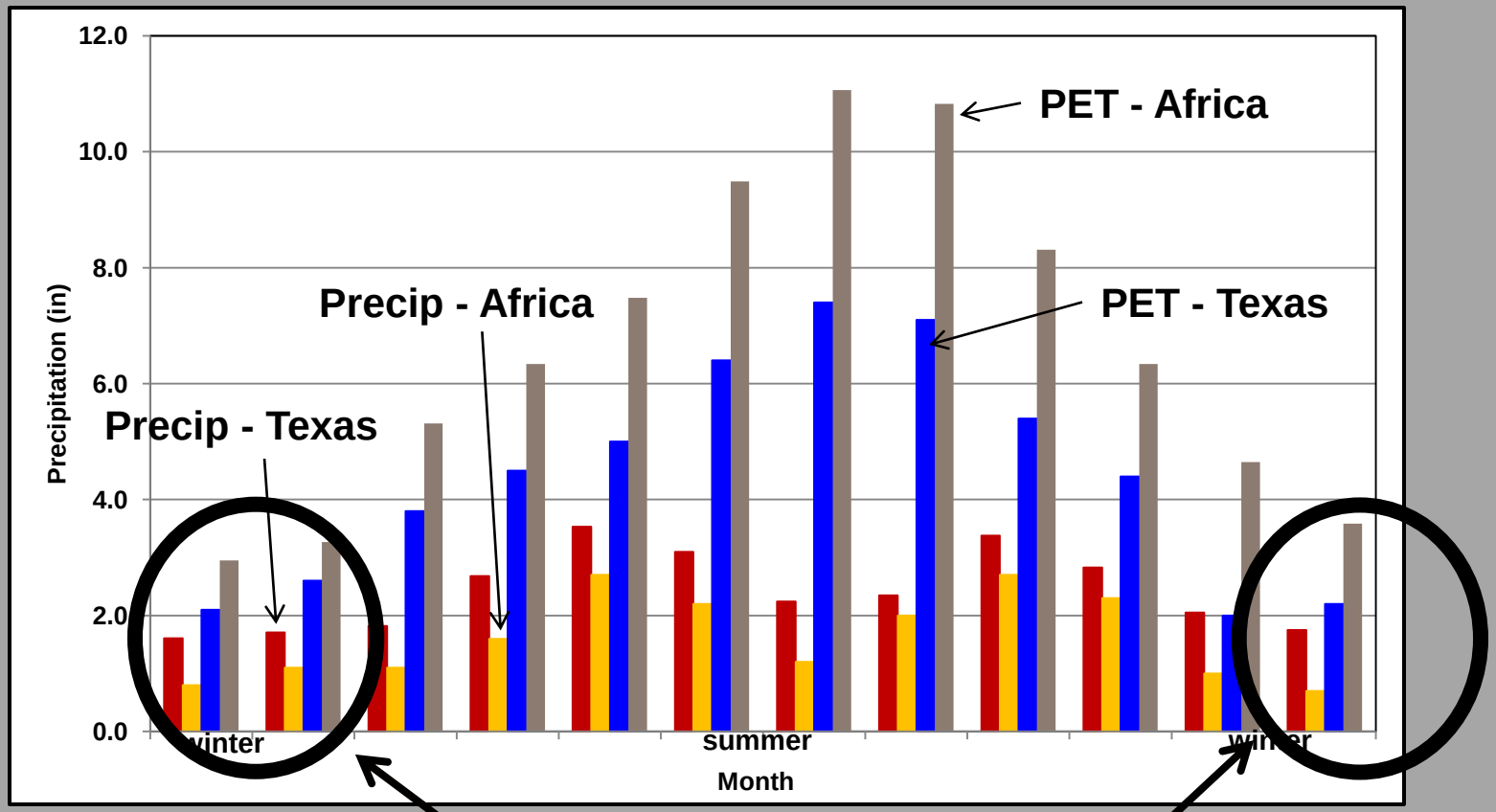
L is the average day length

N is the number of days in the month being calculated

T_α is the average daily temperature

I is a heat index

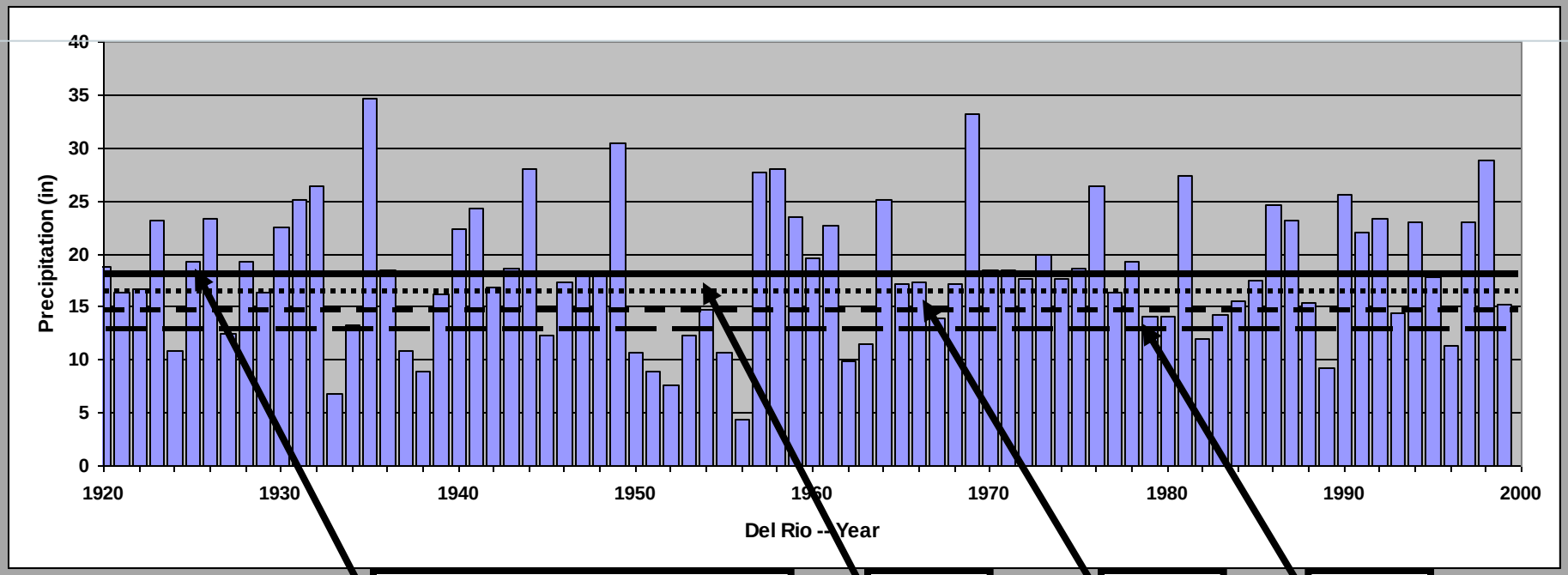
Seasonal Variation in Recharge



Periods when ratio of PET to P is lowest

Annual Variation in Precipitation (and Recharge)

Del Rio, Texas (inch/year) (1920 to 2000)



Long-term Average

10%

20%

30%

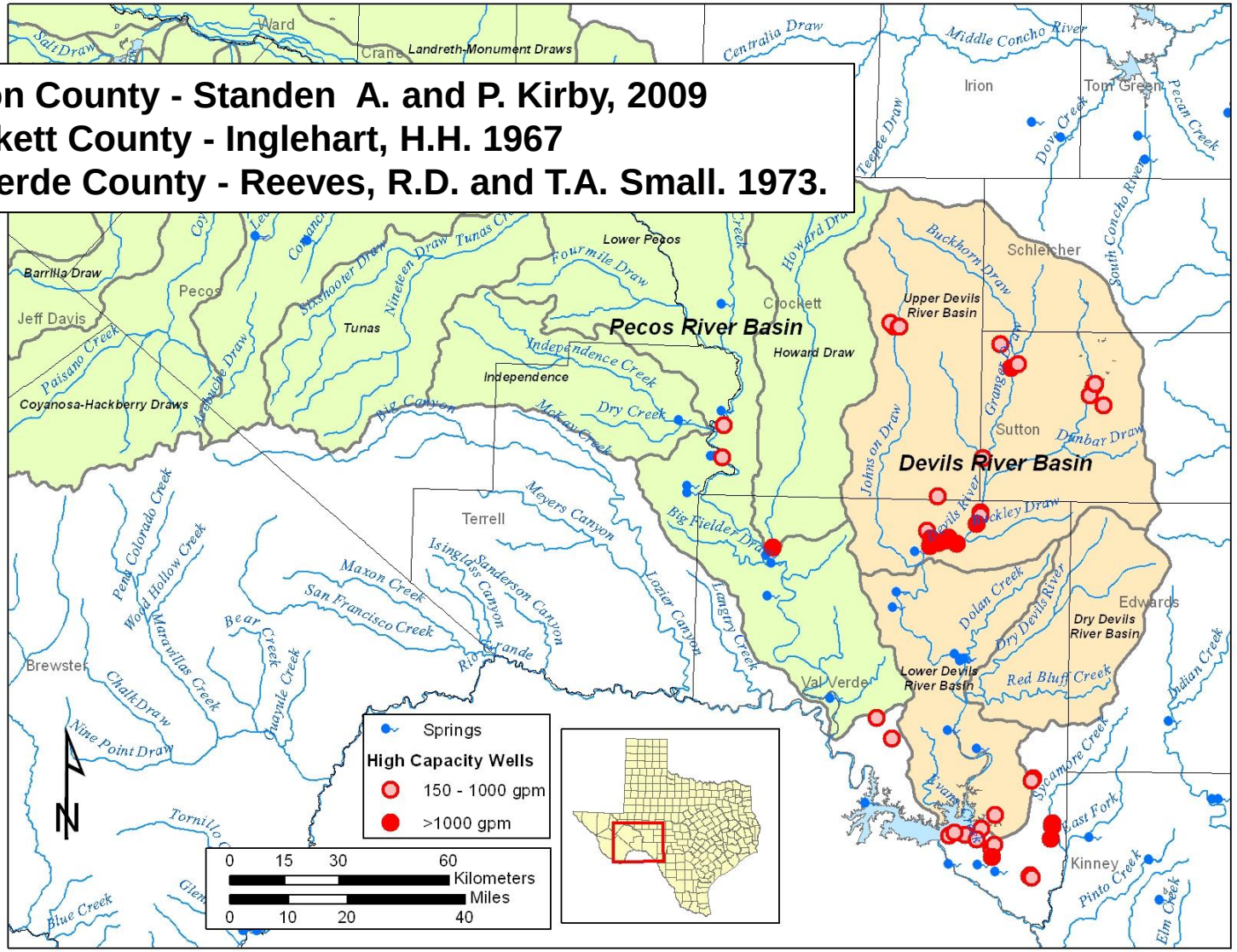
40% occurrence

30% occurrence

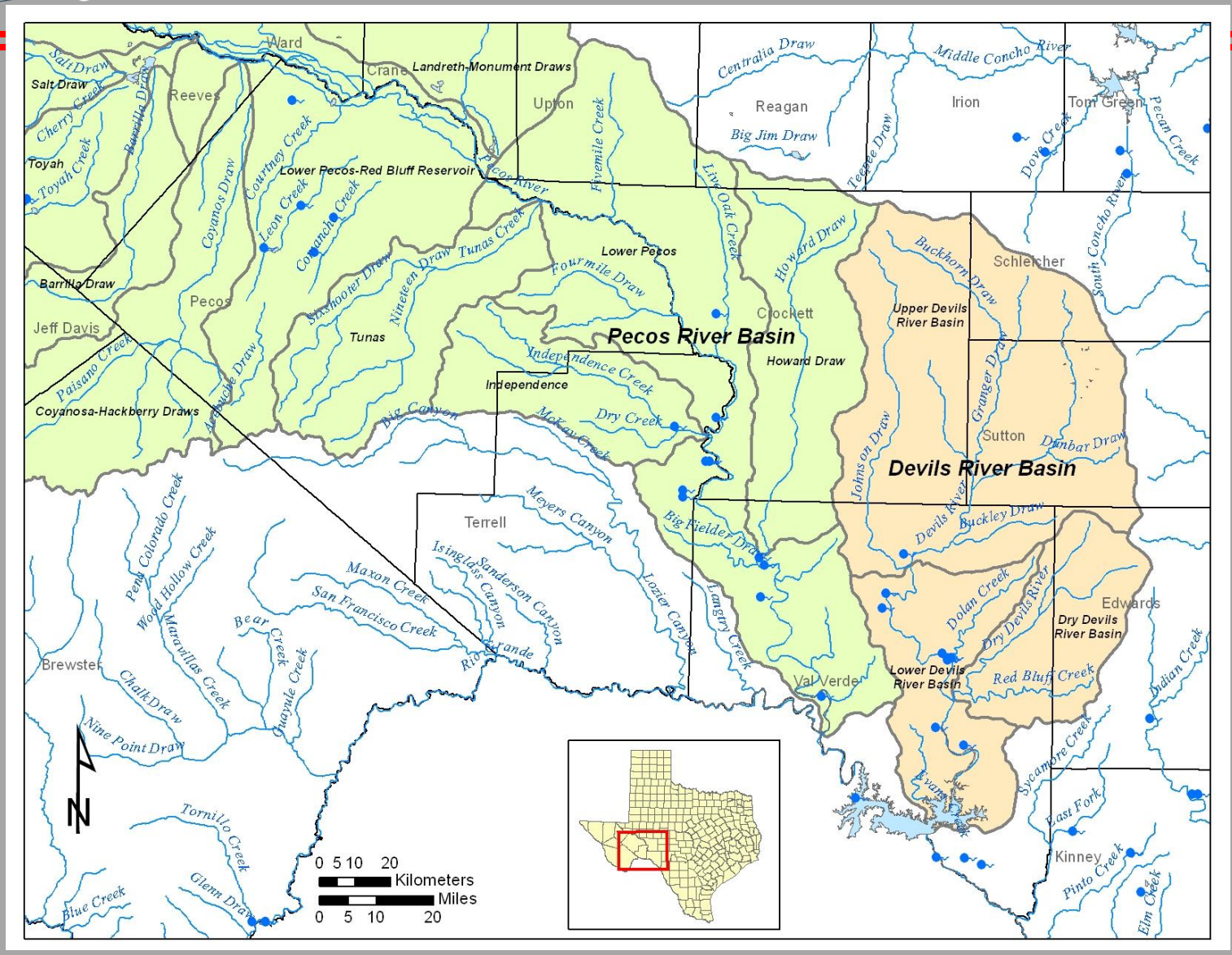
20% occurrence

Where is the Water in the Devil's River Watershed?

Sutton County - Standen A. and P. Kirby, 2009
Crockett County - Inglehart, H.H. 1967
Val Verde County - Reeves, R.D. and T.A. Small. 1973.



What is the Source of Water in the Pecos River and Devil's River Watersheds?



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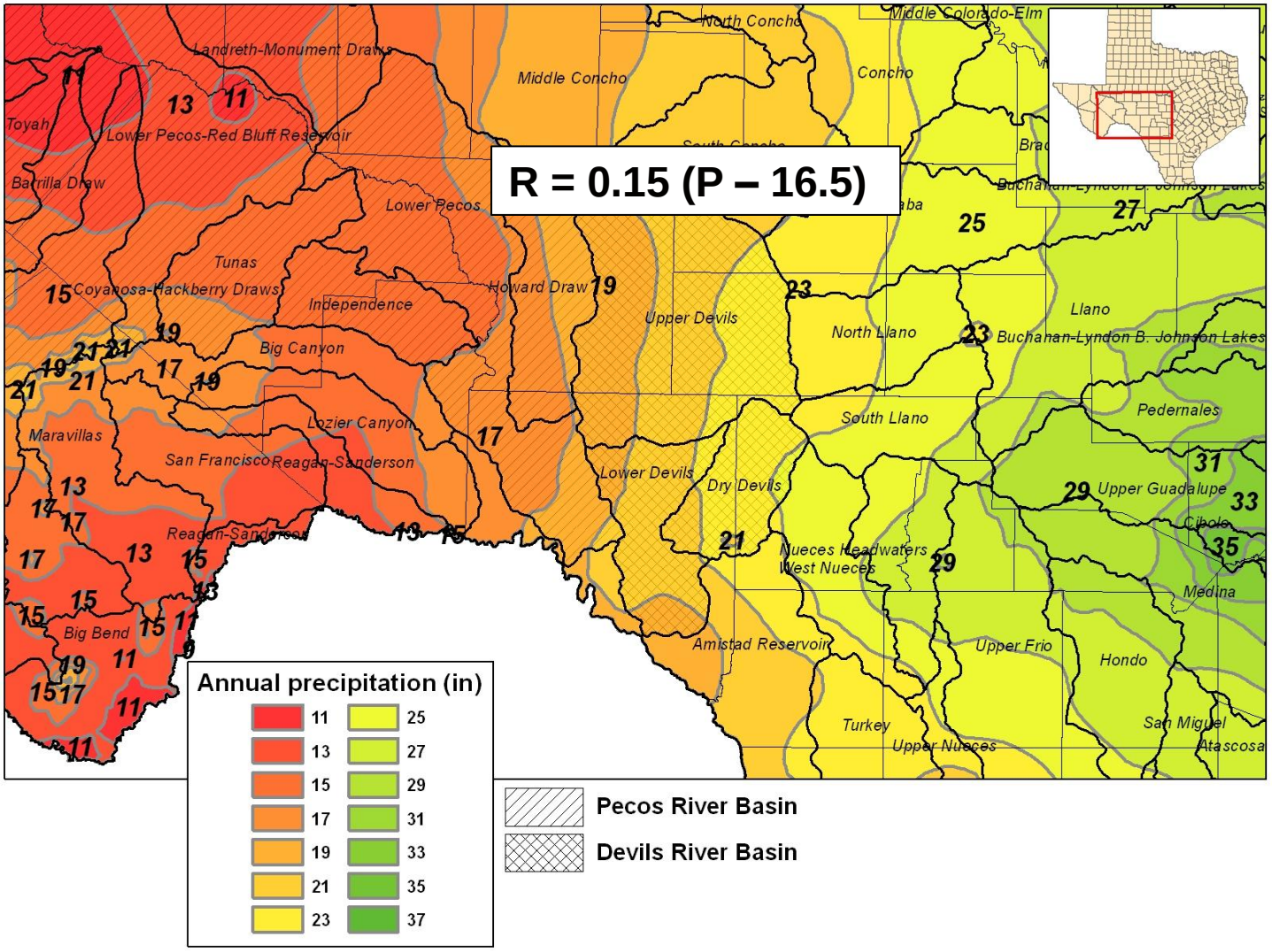

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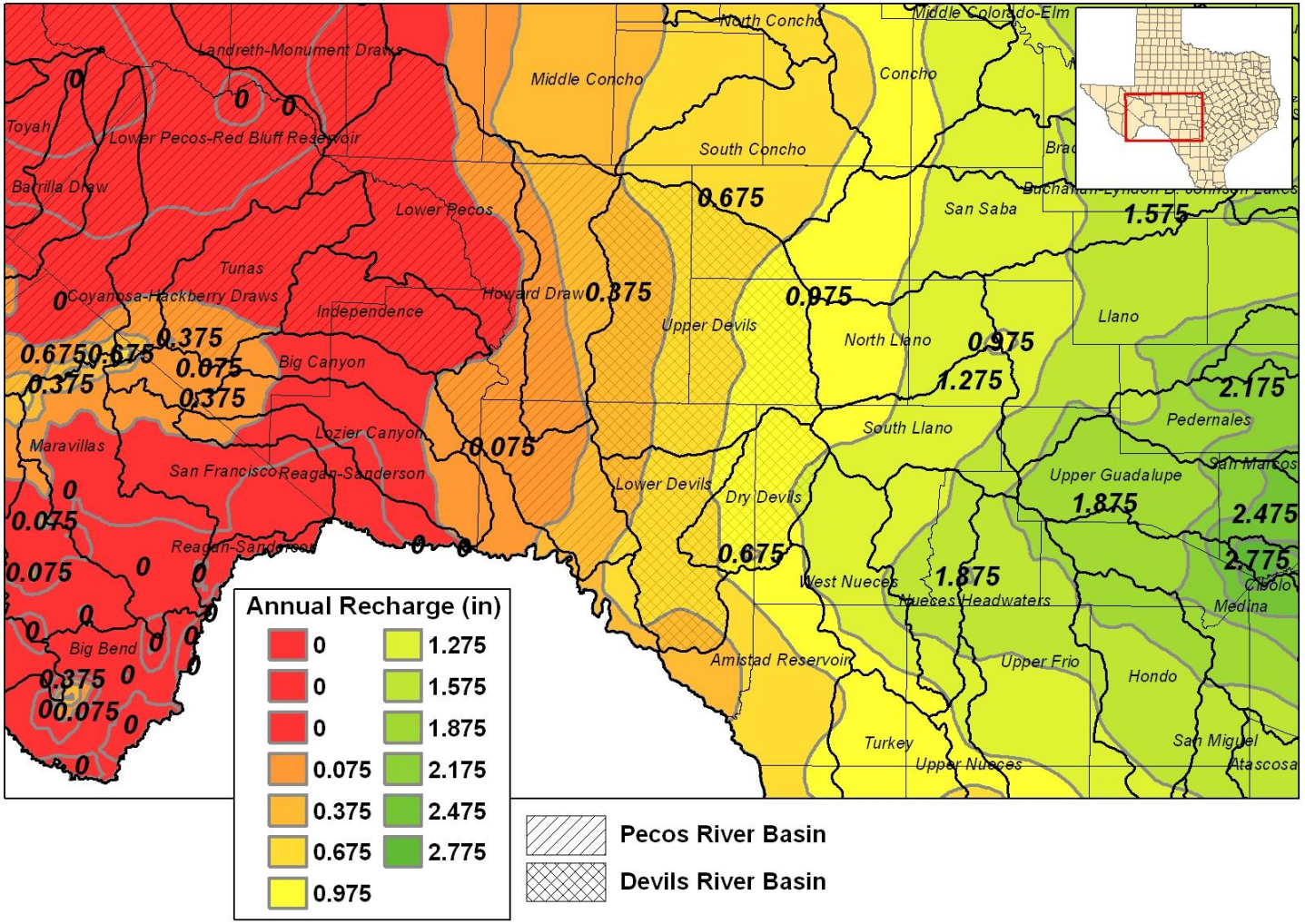
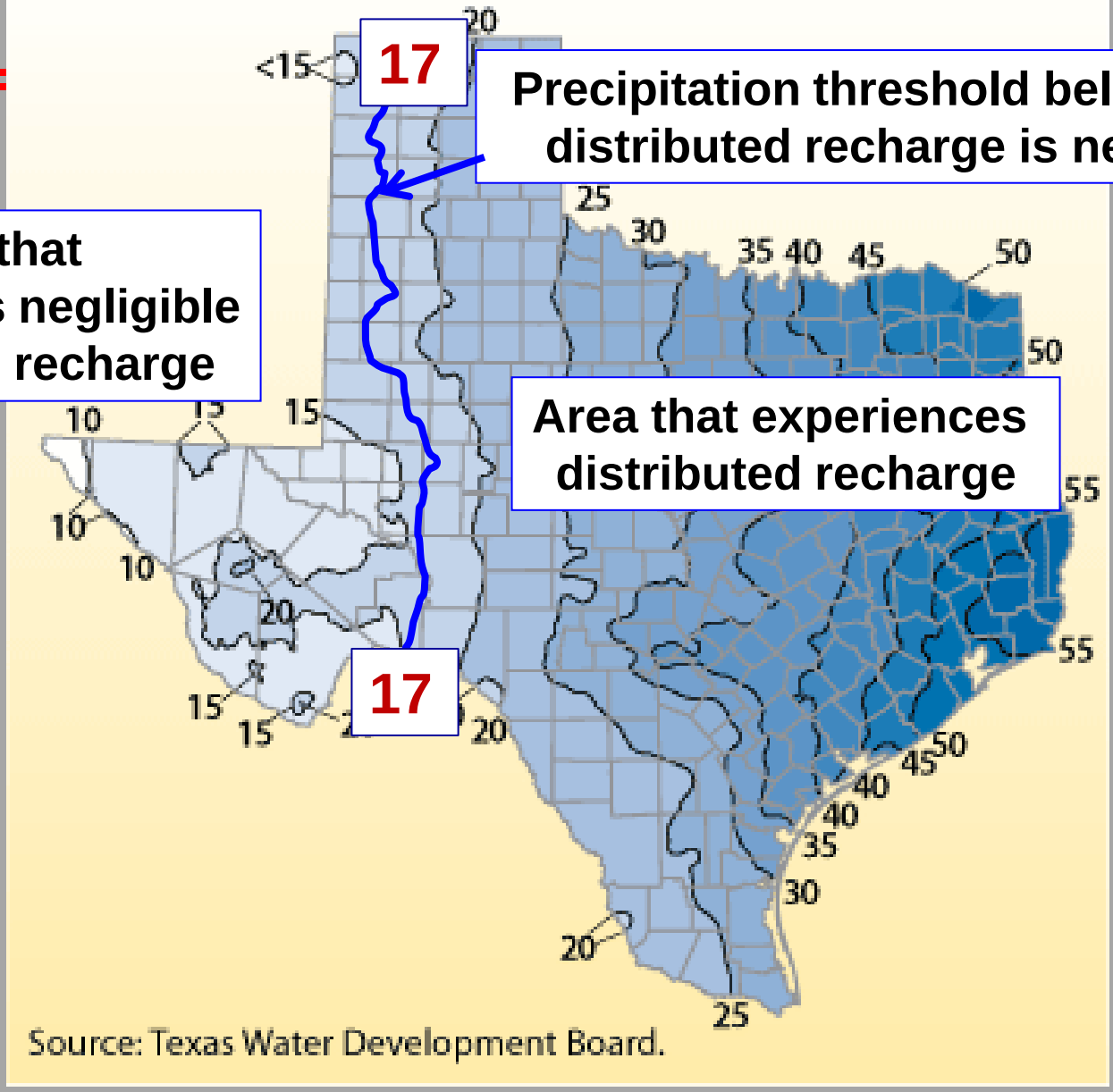


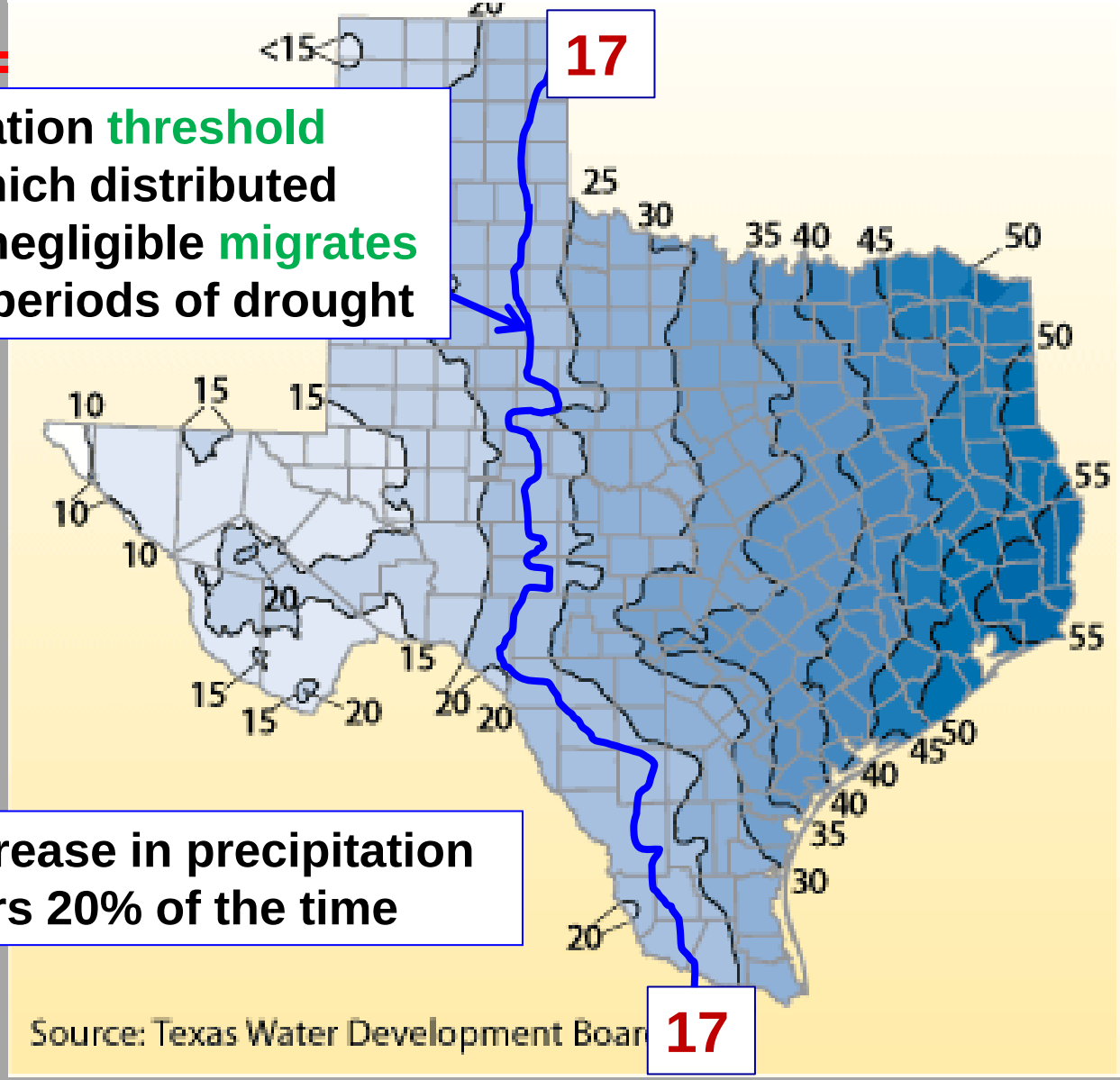
Effect of Climate Change on Recharge in West Texas

Western Texas Experiences Negligible Distributed Recharge during an Average Year



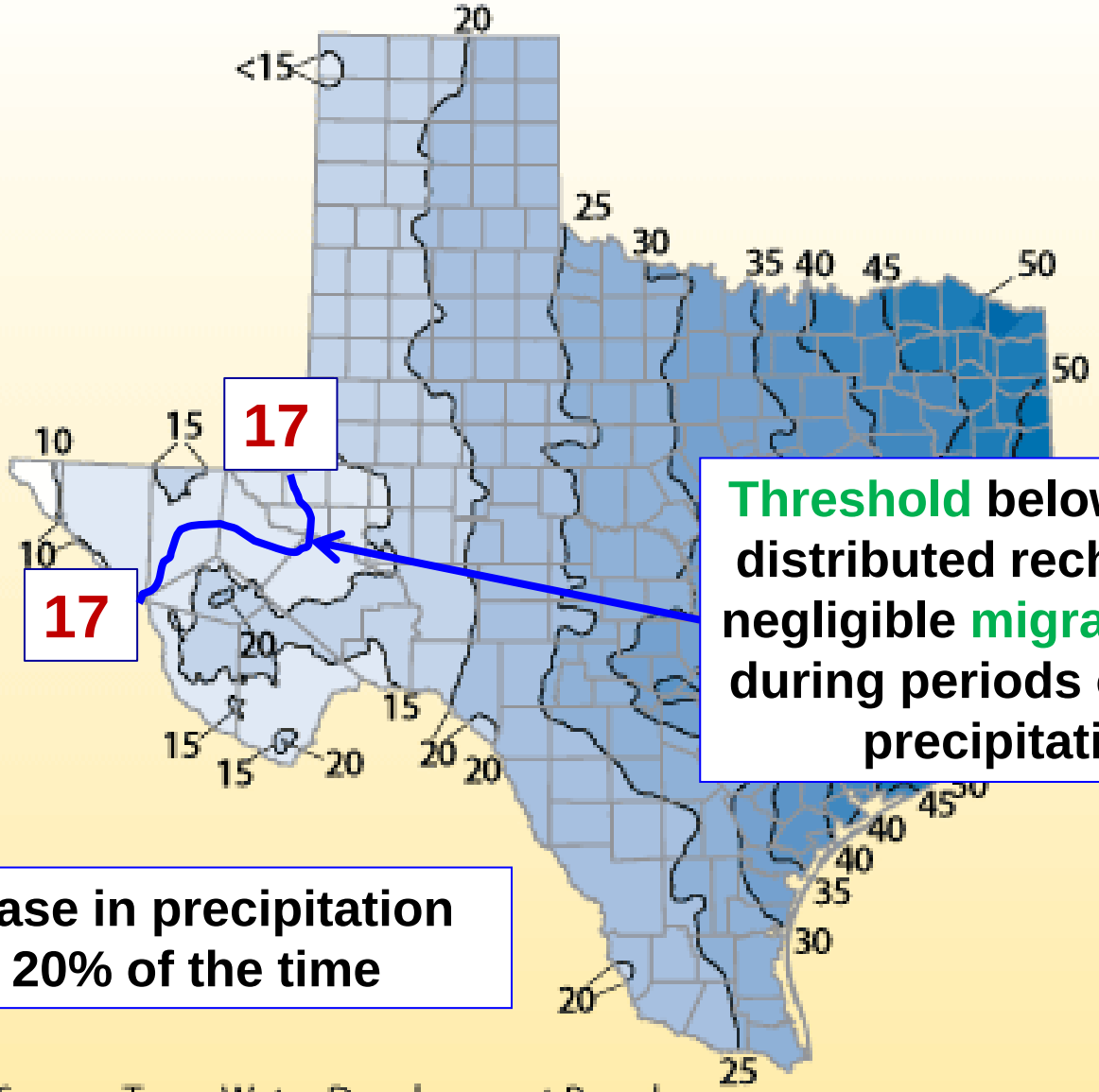
West-Central Texas Experiences Negligible Distributed Recharge during a Dry Year (30% decrease)

Precipitation threshold below which distributed recharge is negligible migrates east during periods of drought



30% decrease in precipitation occurs 20% of the time

Greater Area Experiences Distributed Recharge during a Wet Year (30% increase)

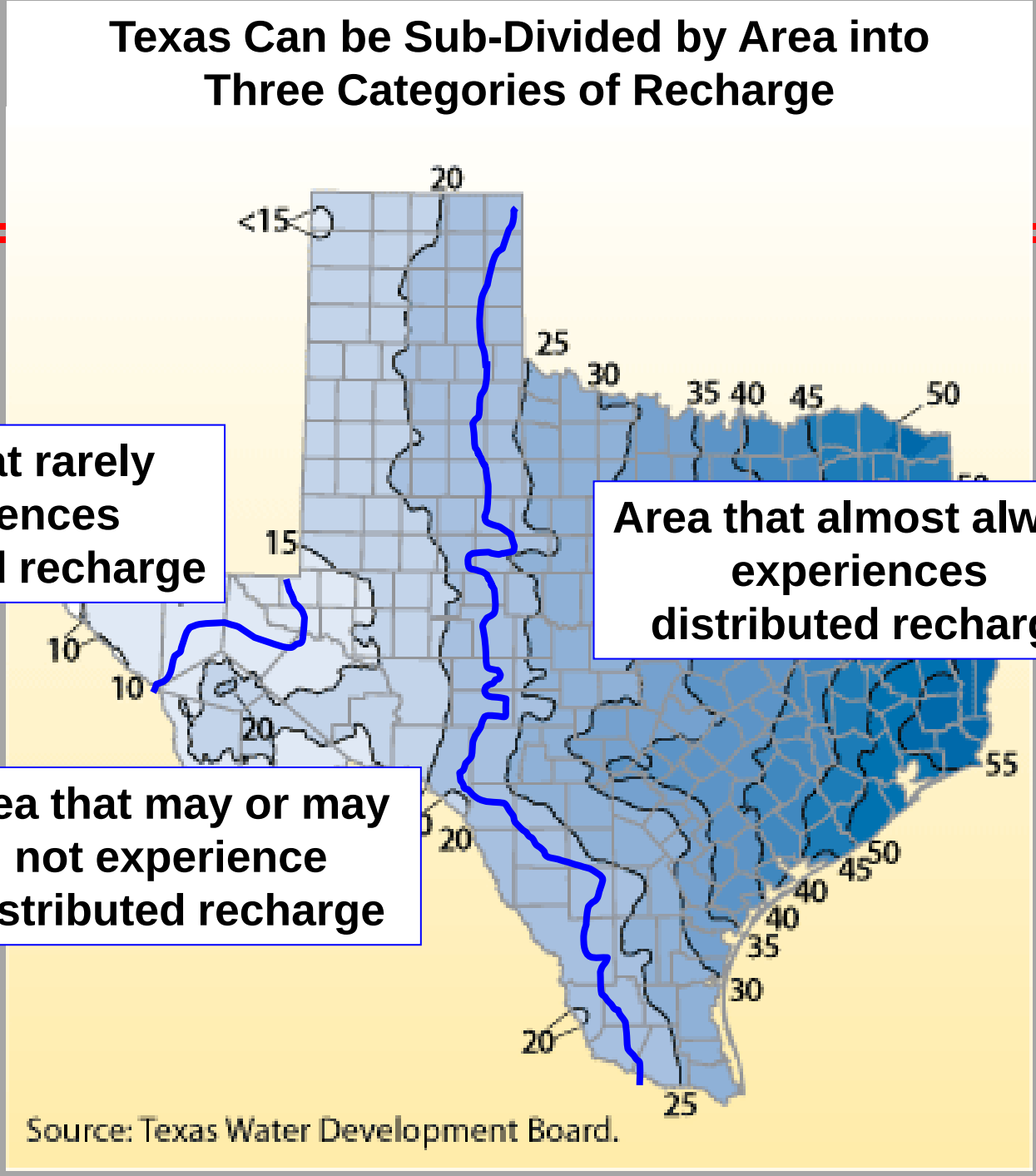


Source: Texas Water Development Board.

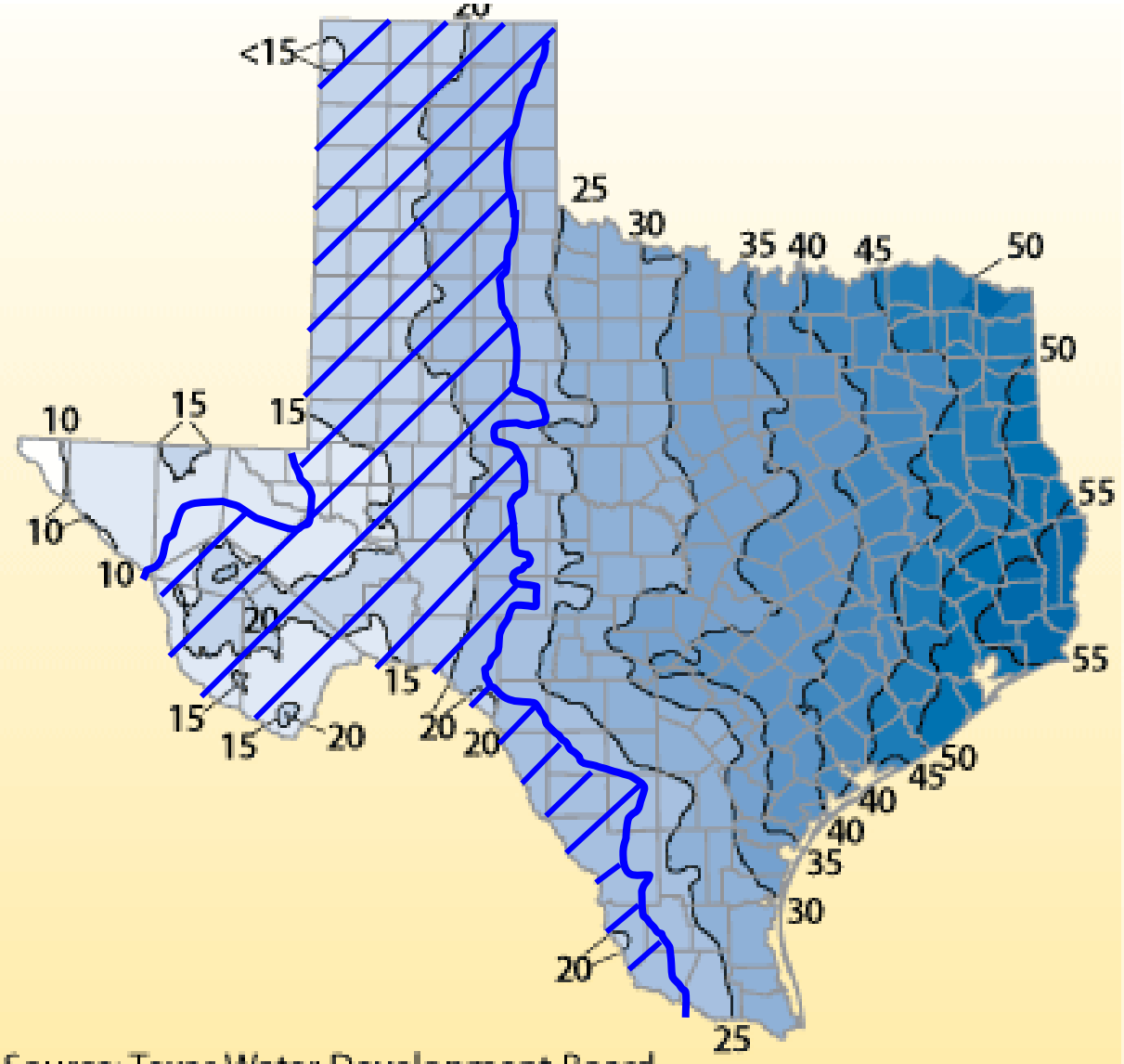
Threshold below which distributed recharge is negligible migrates west during periods of heavy precipitation

30% increase in precipitation occurs 20% of the time

Texas Can be Sub-Divided by Area into Three Categories of Recharge



Intermediate Zone for Distributed Recharge Does Not Provide Dependable, Sustainable Sources for Water Supply



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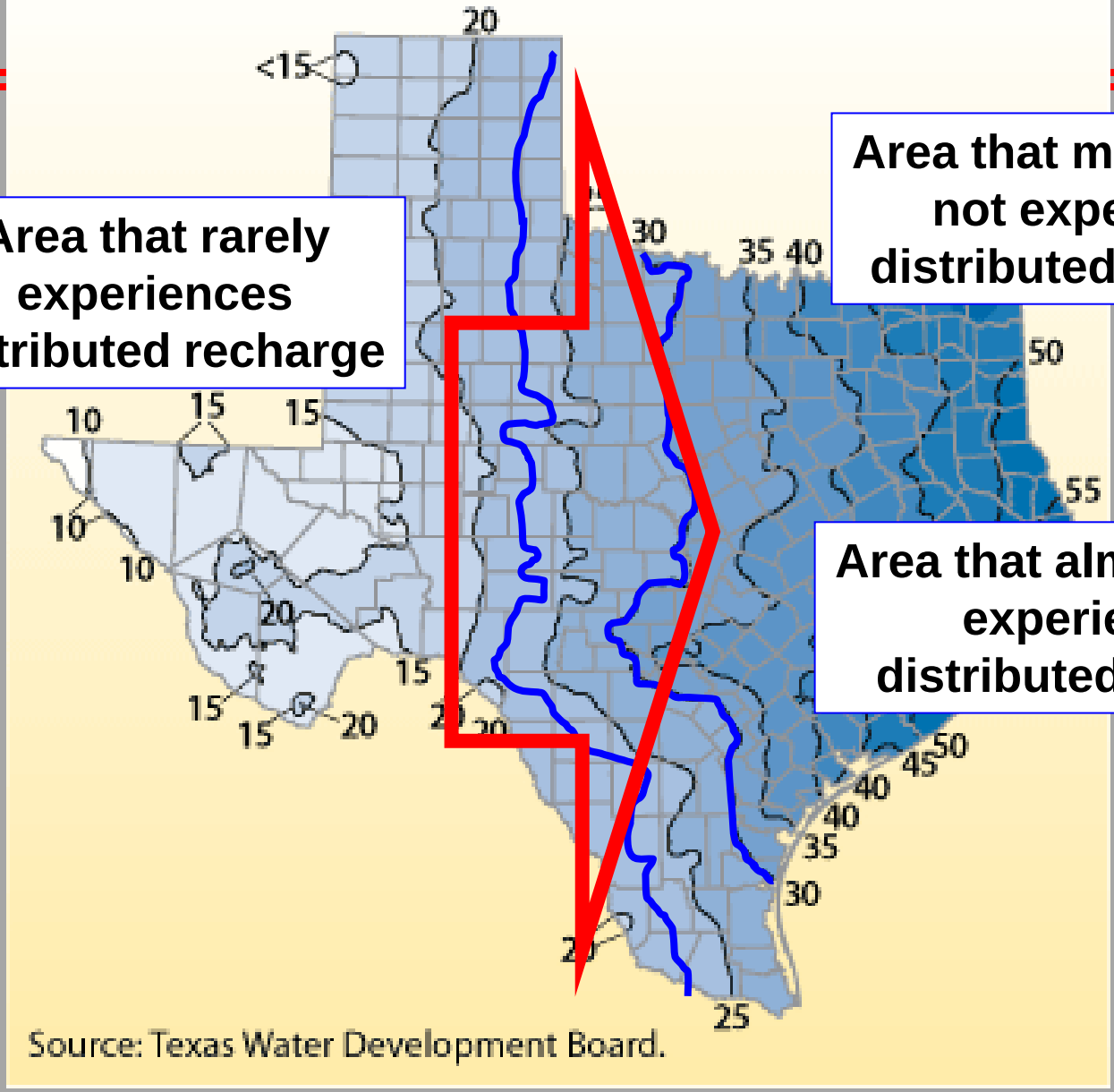
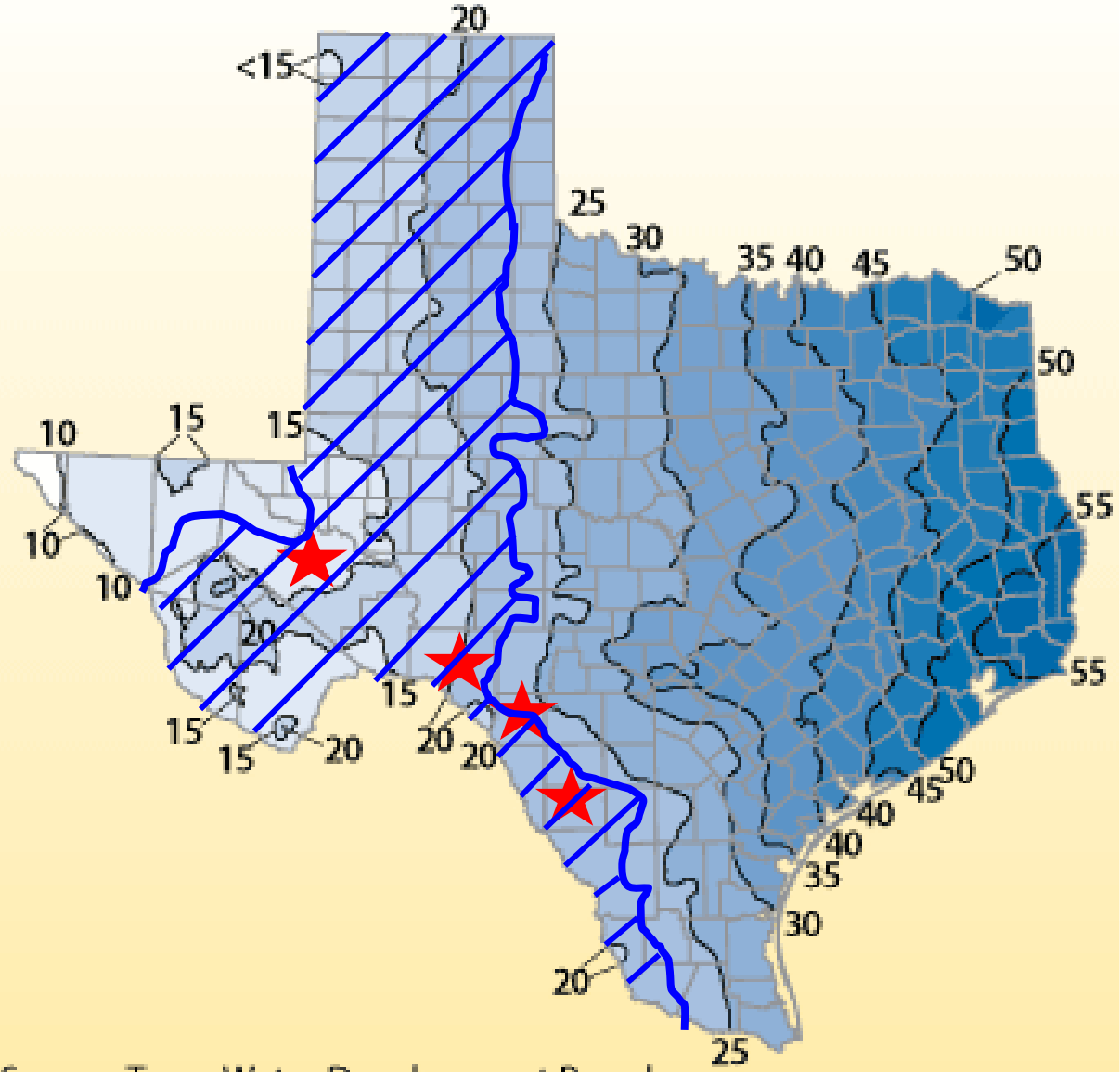
Climate Change that Causes Less Precipitation in Texas Will Shift these Zones to the East



Locations in Intermediate Zone Targeted for Inter-Basin Transfer and Pipeline Construction



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Summary

- Arid and semi-arid regions are vulnerable to limited recharge during periods of drought
- Studies in west-central Texas indicate that recharge becomes negligible when precipitation decreases below a threshold of 15-17 in/yr (confirmed with S. Africa data)
- Conveyance of water in Edwards-Trinity Aquifer associated with river channels
- Recharge is limited, uncertain, and varies from year to year
- Climate change **could** exacerbate water shortage by increasing magnitude of variability and reducing precipitation/recharge

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