
Sutton County
Underground Water
Conservation District

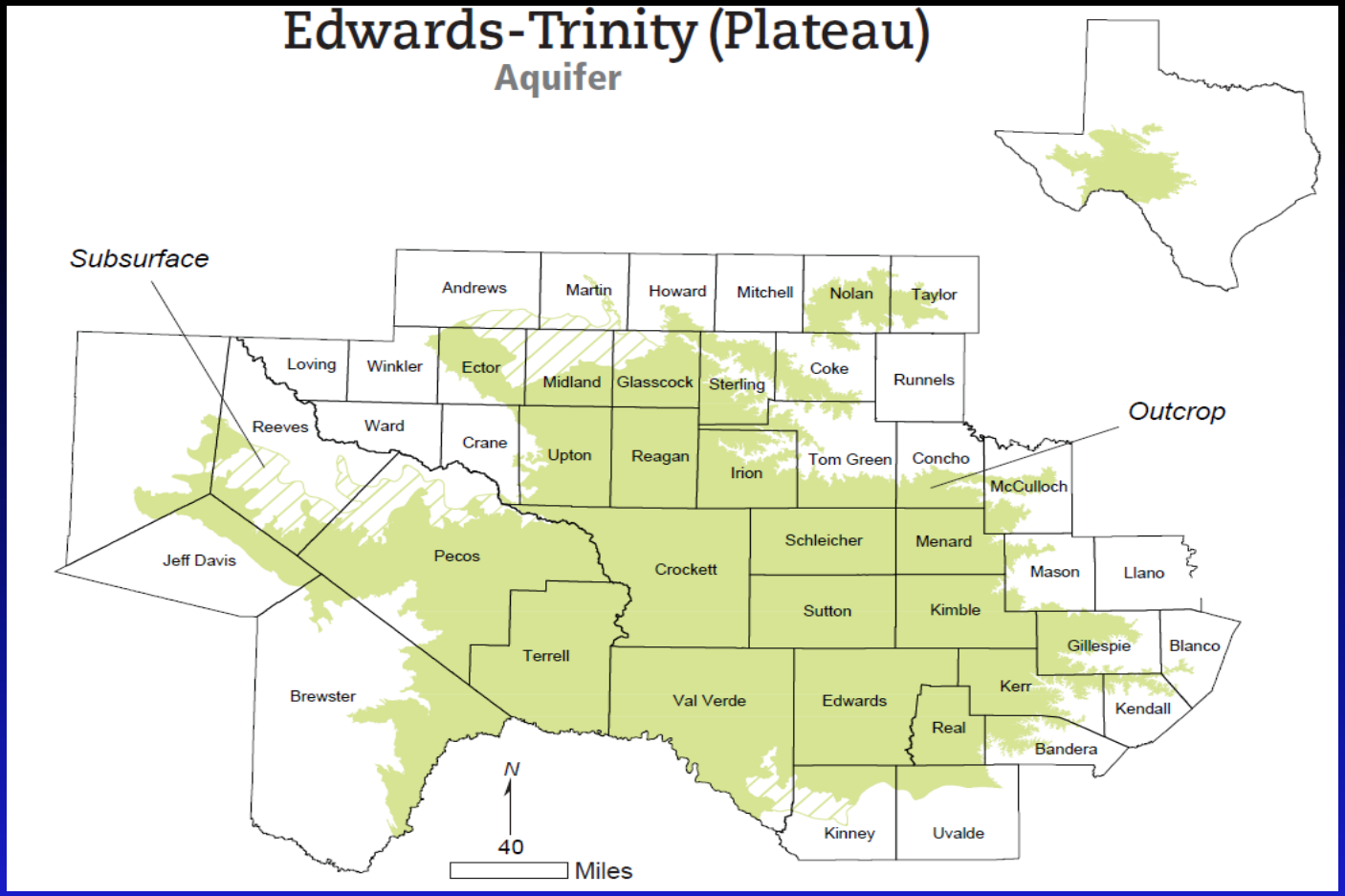
Sutton County UWCD
301 S. Crockett Ave.
Sonora, TX 76950

Water is Life

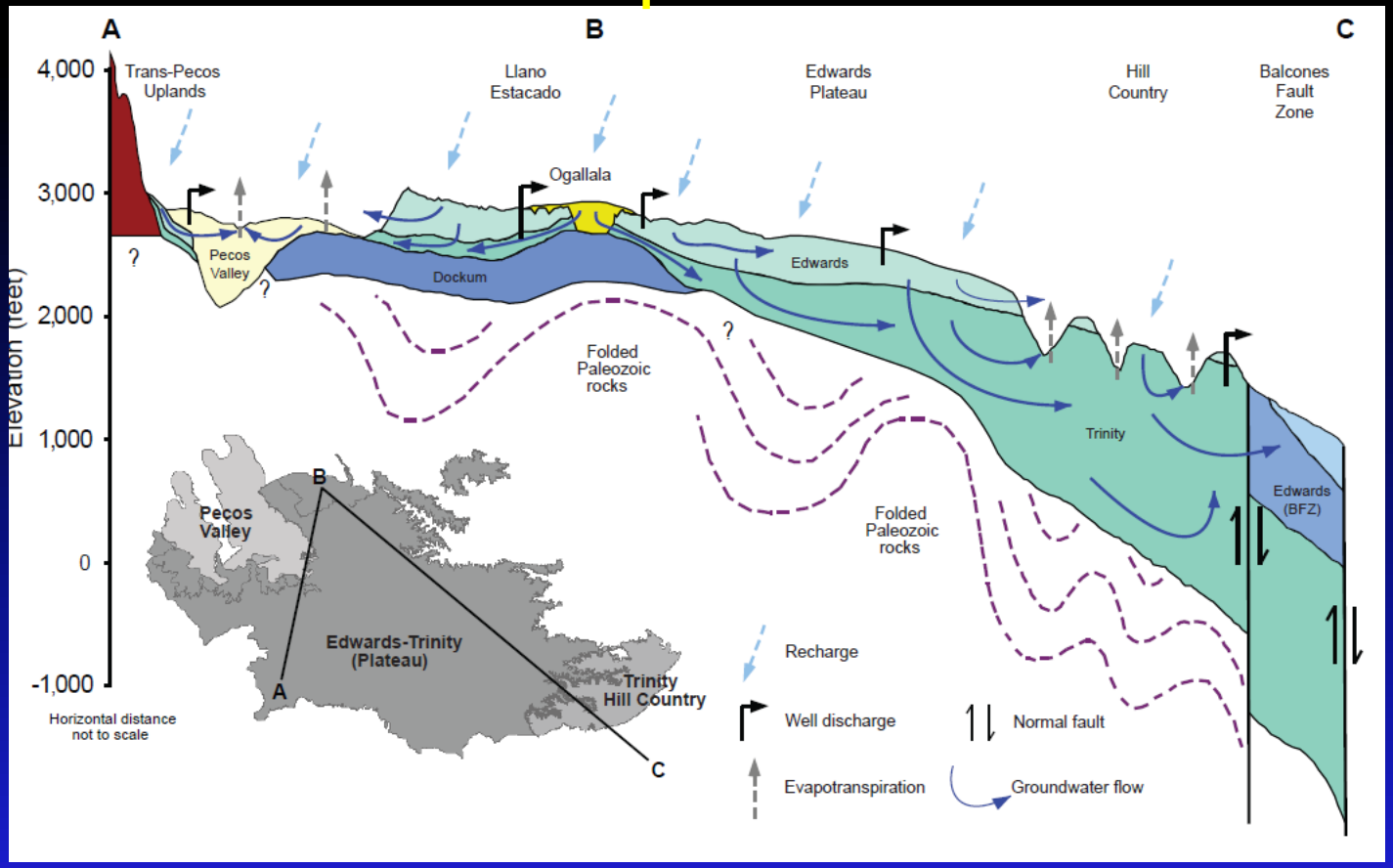
Water is Life

- Basic hydrogeology of Sutton County and surrounding area
- Where data is collected by the Sutton County UWCD
- How data is collected and utilized
- A word about rainfall
- Drought Contingency Plan
- Transportation Rule

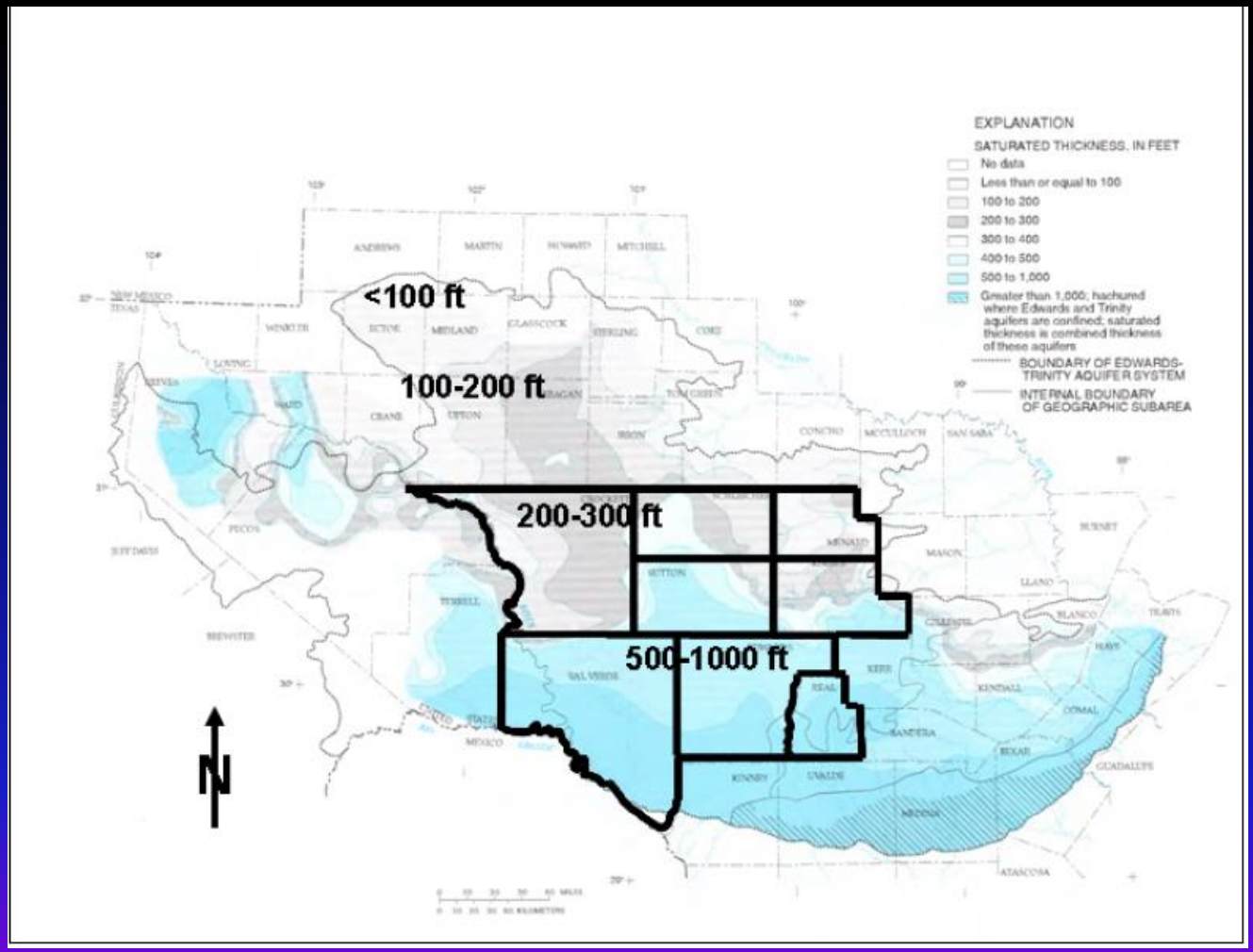
Basic Hydrogeology of Sutton County


Edwards-Trinity (Plateau)
Aquifer
Subsurface
Outcrop
Andrews
Martin
Howard
Mitchell
Nolan
Taylor
Loving
Winkler
Ector
Midland
Glasscock
Sterling
Coke
Runnels
Reeves
Ward
Crane
Upton
Reagan
Irion
Tom Green
Concho
McCulloch
Jeff Davis
Pecos
Crockett
Schleicher
Menard
Mason
Llano
Sutton
Kimble
Gillespie
Blanco
Terrell
Brewster
Val Verde
Edwards
Kerr
Kendall
Real
Bandera
Kinney
Uvalde
N
40
Miles

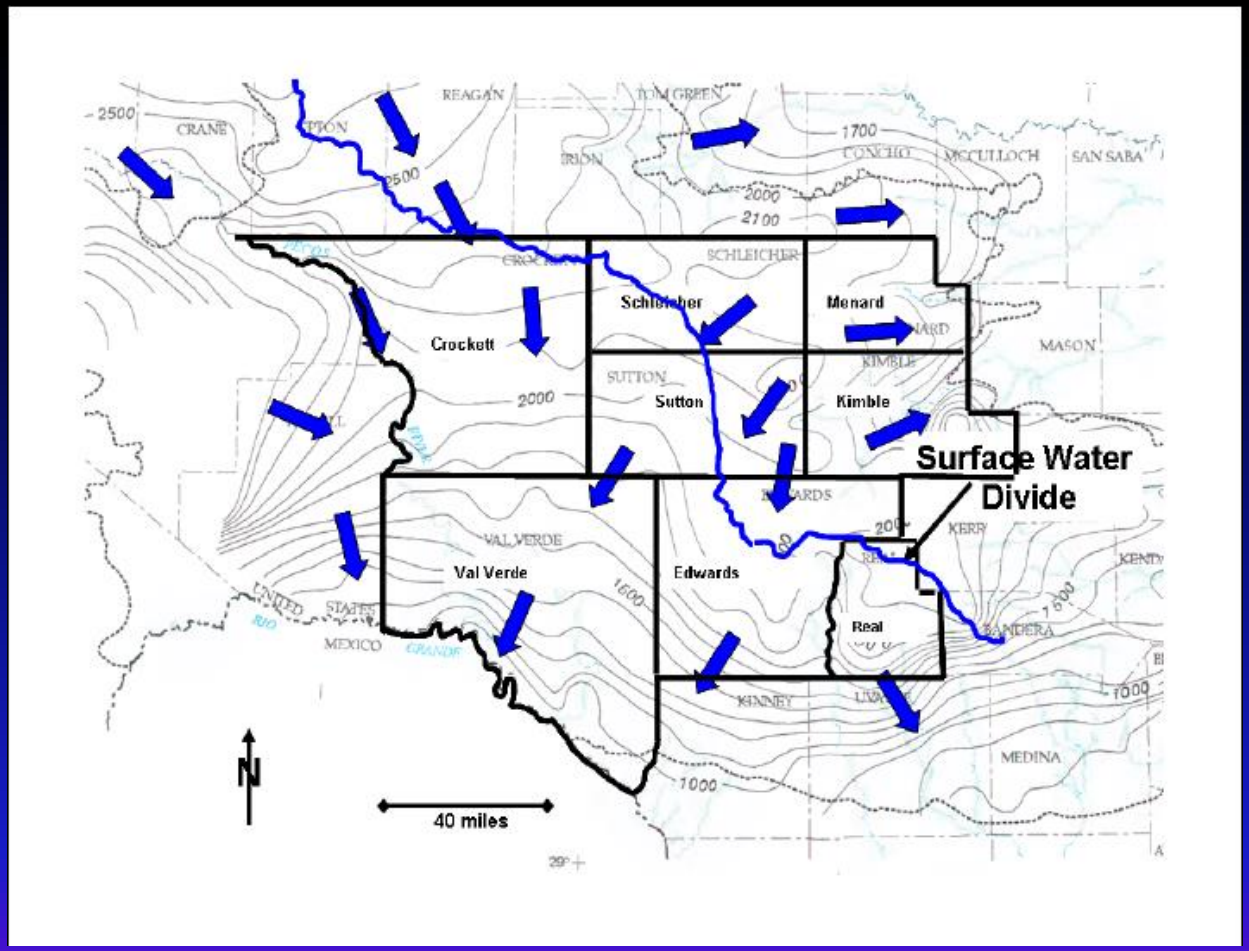
Vertical Cross-Section Edwards-Trinity Aquifer



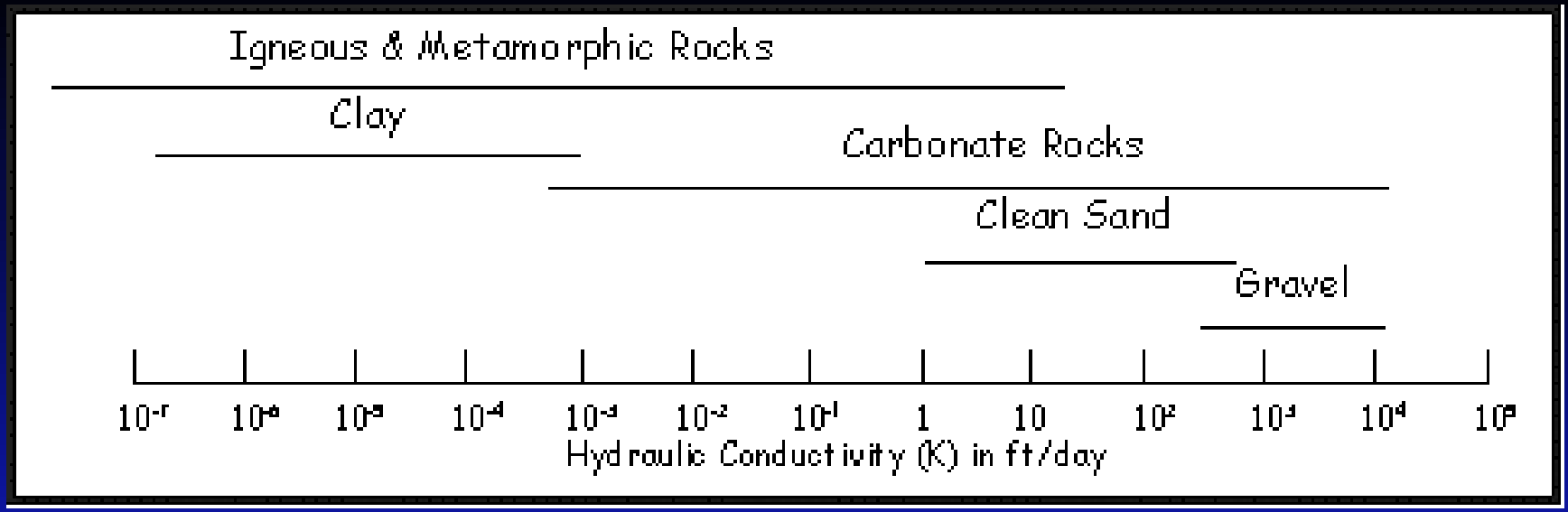
Saturated Thickness of the Edwards-Trinity Aquifer



Flow Paths Through the Edwards-Trinity Aquifer



Hydraulic Conductivity (speed water travels through an aquifer)



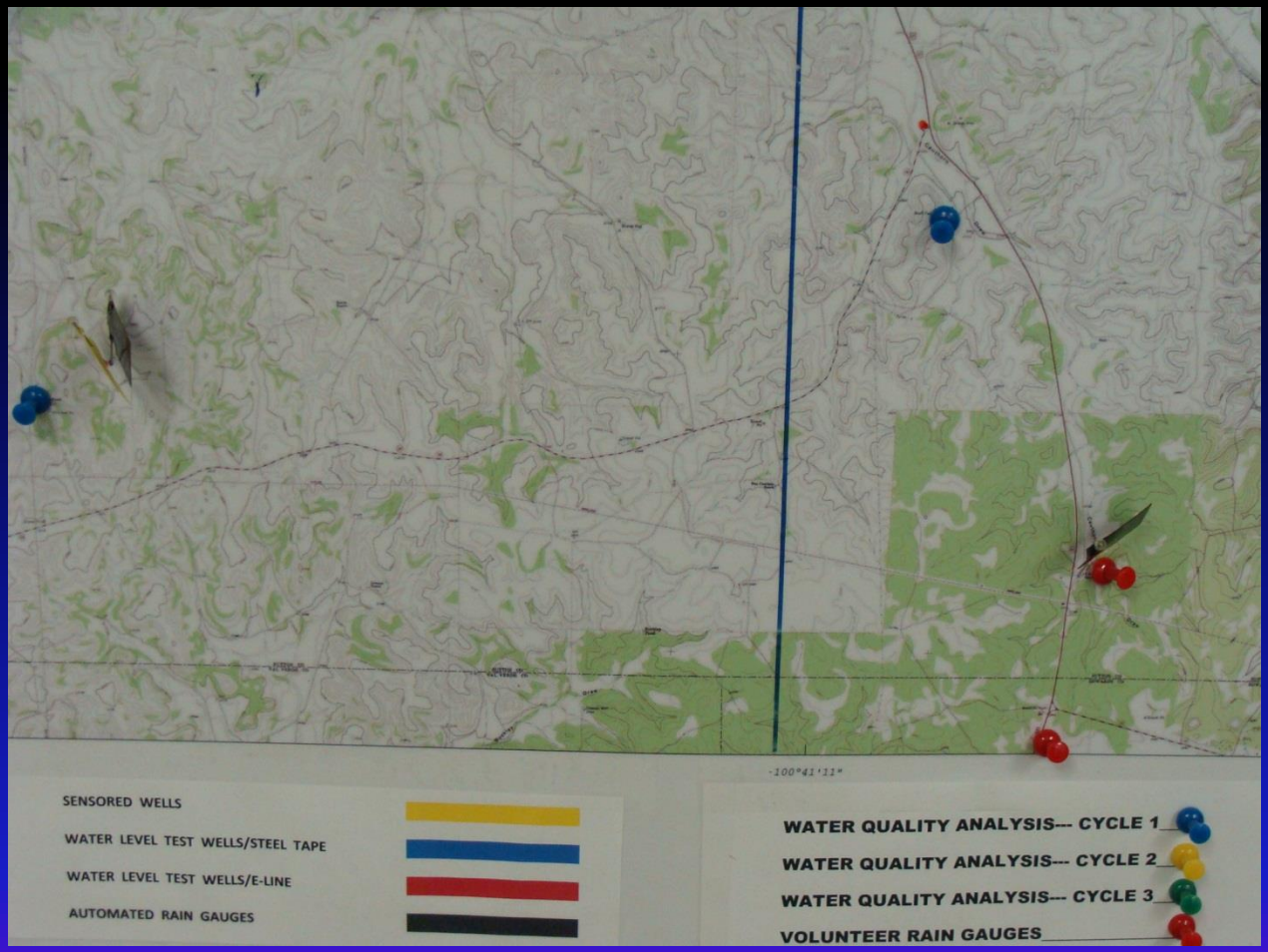
Sutton County UWCD Data Collection

Instrumentation and Data collected by the District

- Water Levels - 31 Wells strategically located throughout the District
  - 15 wells with automated sensors
  - 14 wells measured with a steel tape
  - 2 wells measured with an electric (E) line
- Rain Gauges – 41 throughout the District
  - 31 automated rain gauges throughout the county
  - 10 graduated gauges located throughout Sonora
- Water Quality Wells – 60 wells divided into three groups of 20 each
  - Extensive water quality analyses performed on each well sampled

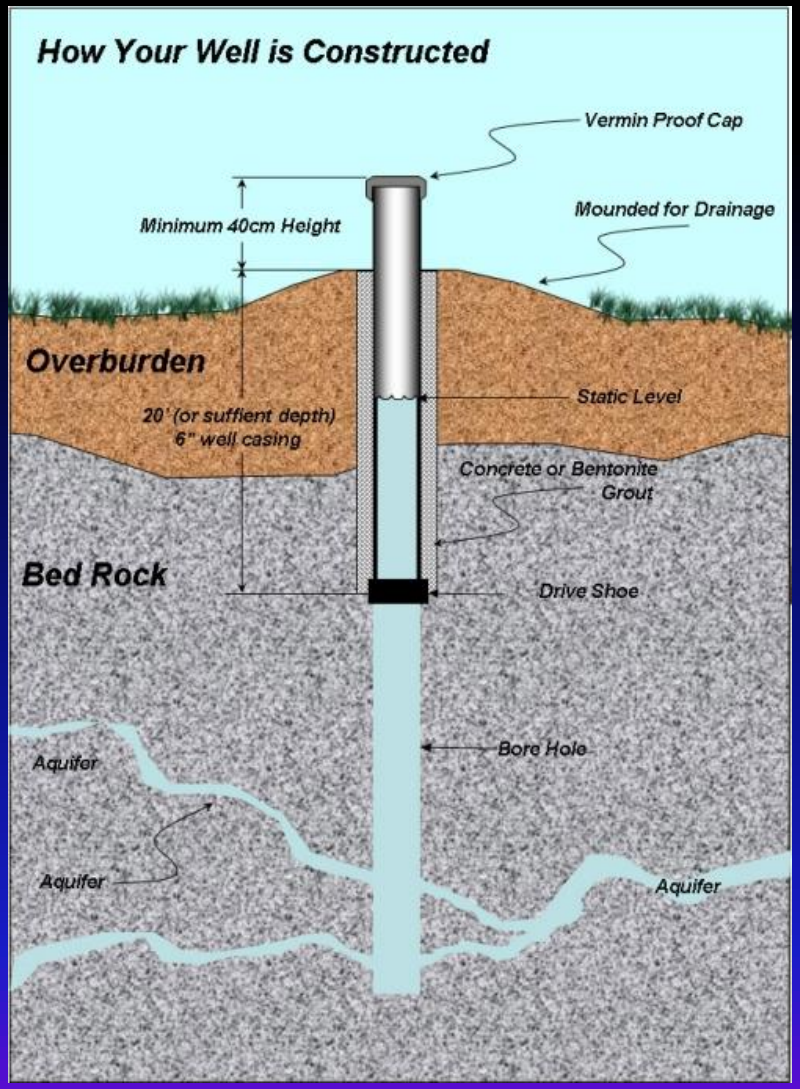
Sutton County UWCD Instrumentation Sites

Close-Up of Data Collection Sites and Legend



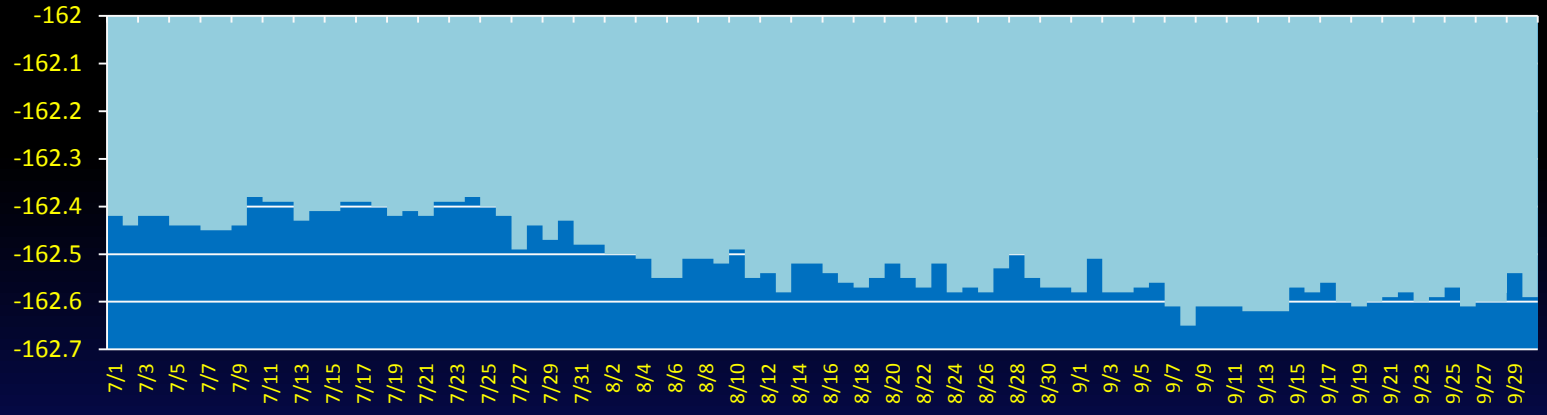
Cross Section Drought Index Well

Cross Section of Monitor Well

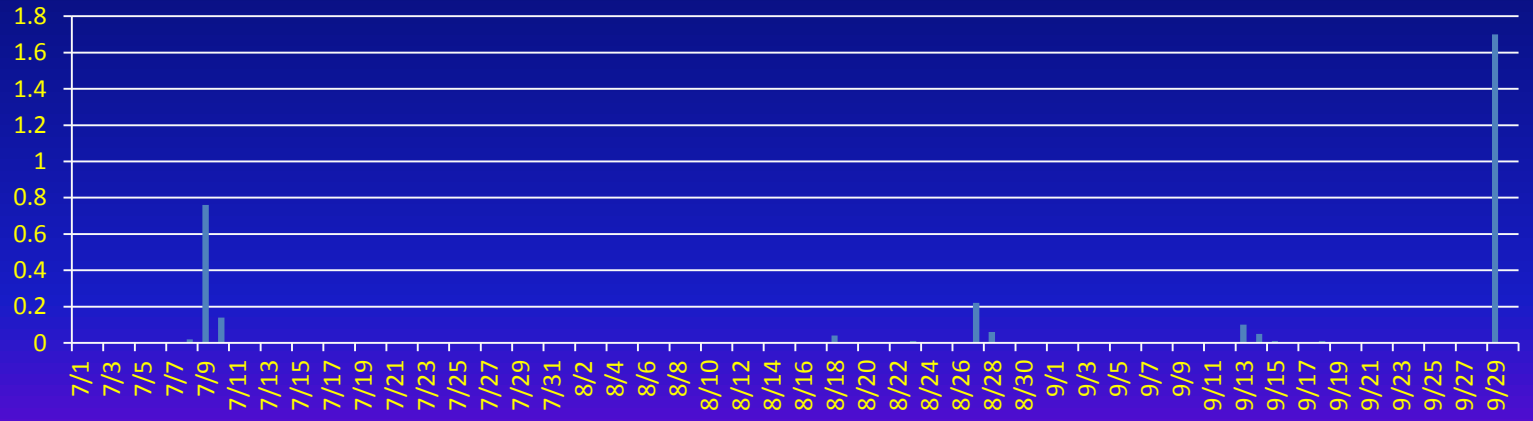


Examples of Water Level Data

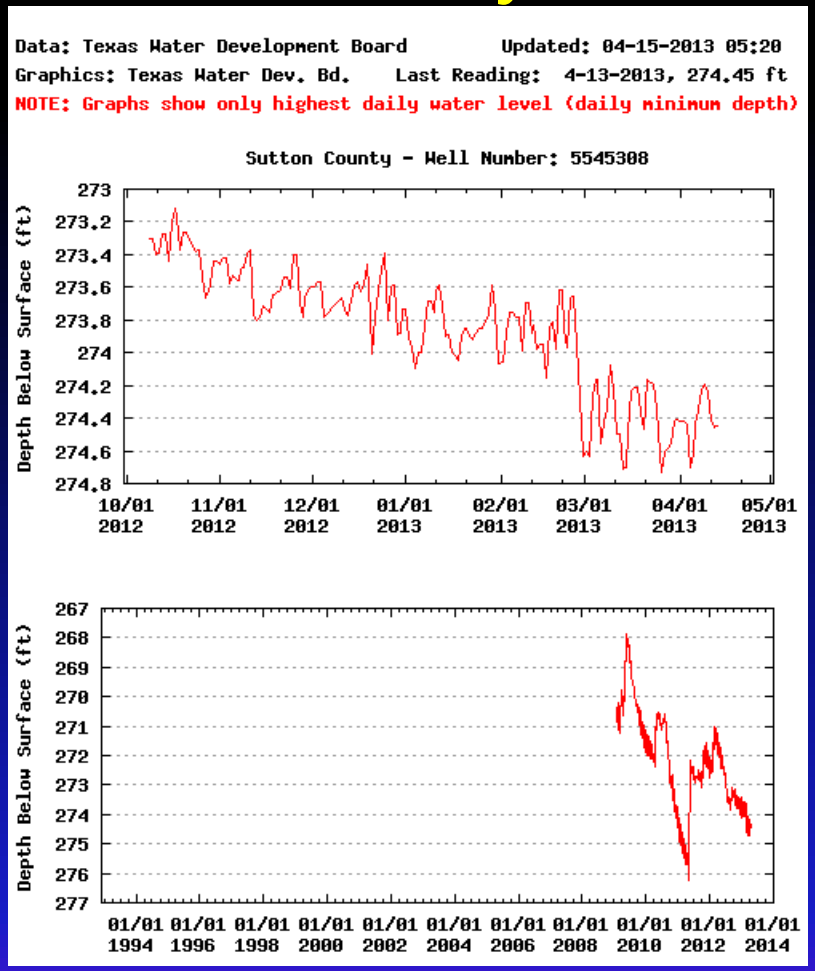
SUTUWCD DCW 3rd Qtr. 2012 55-27-322 SN#: 305080
Level Surface Elevation (ft)



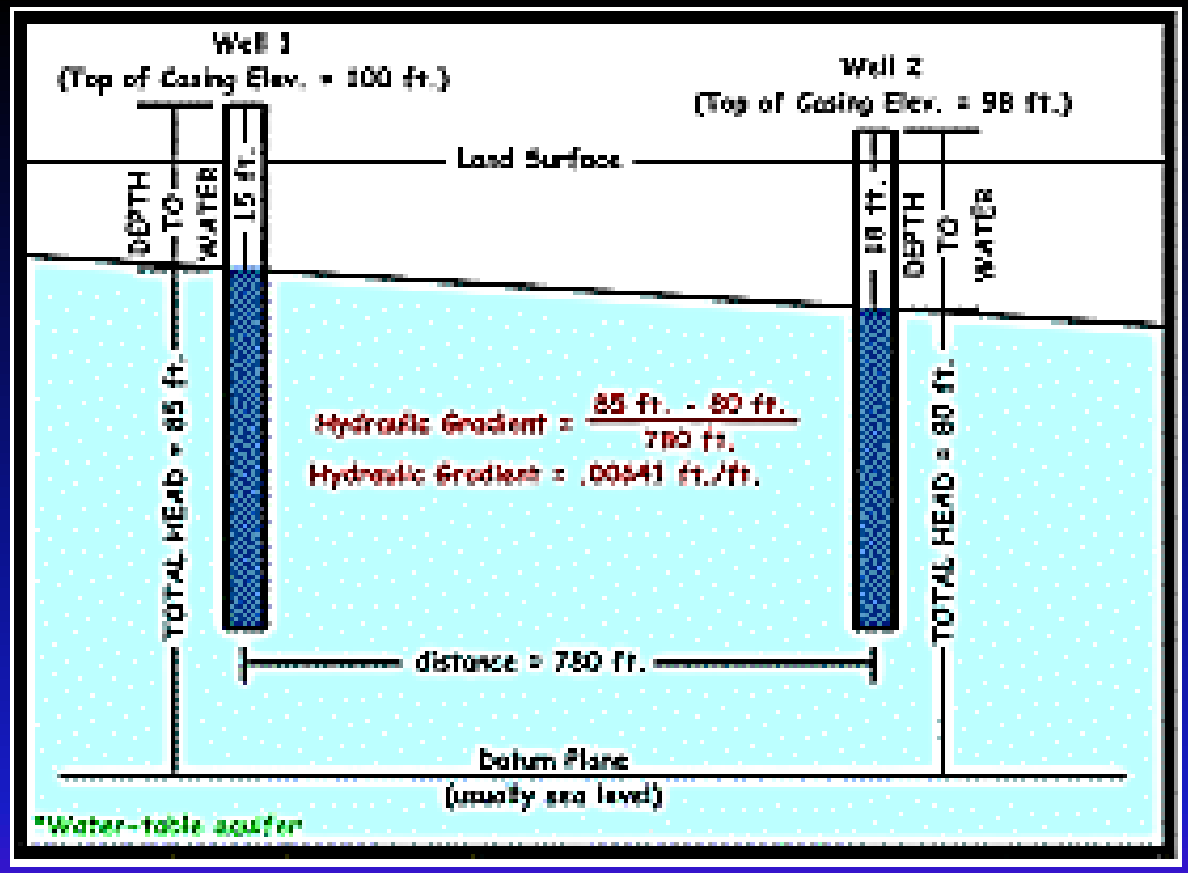
Sum: Event (Rainfall) SUTUWCD DCW RMS #30 3rd Qtr. 2012
3.12" total



TWDB Satellite Linked Monitor Well – Sutton County

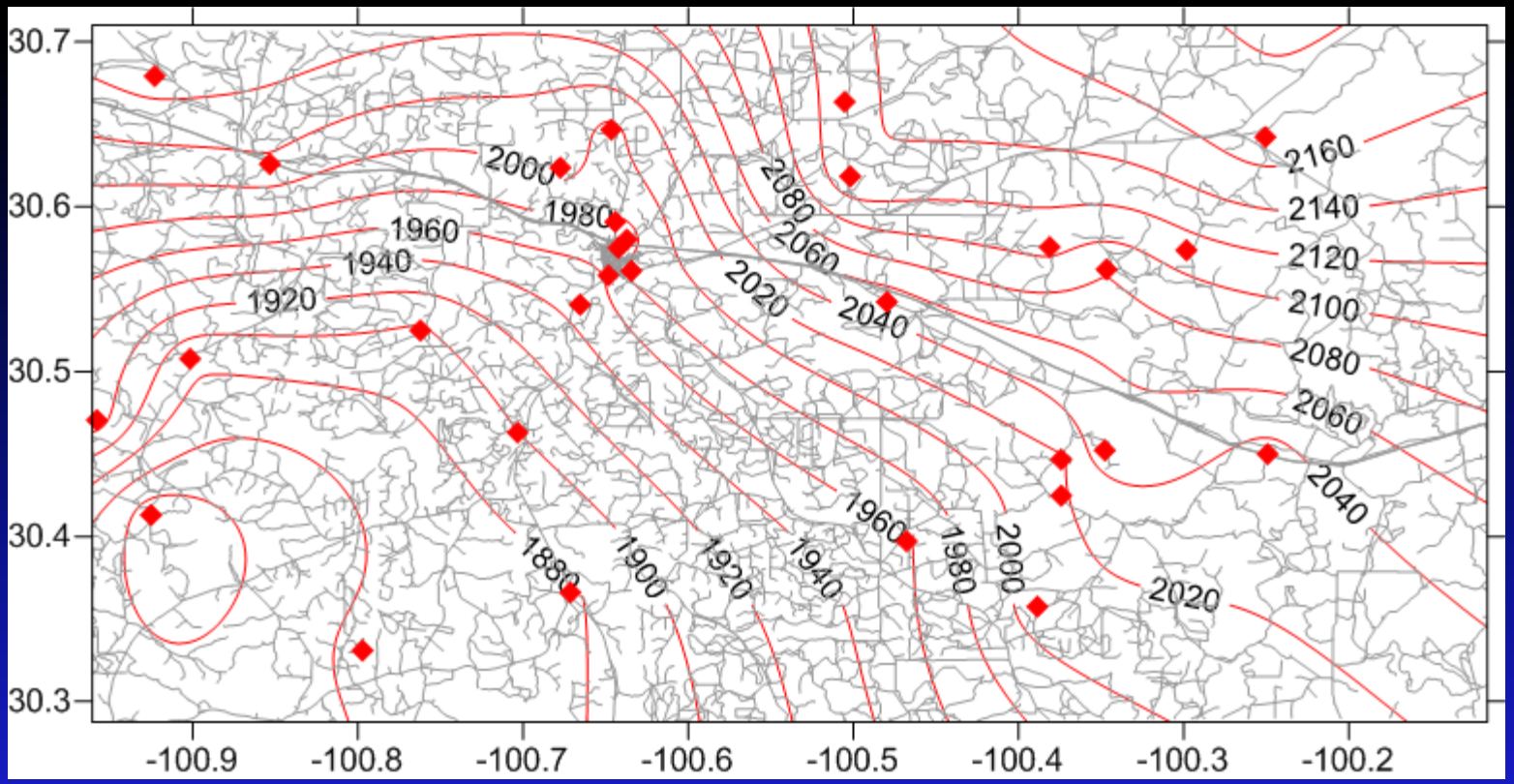


Water Level Monitoring Wells

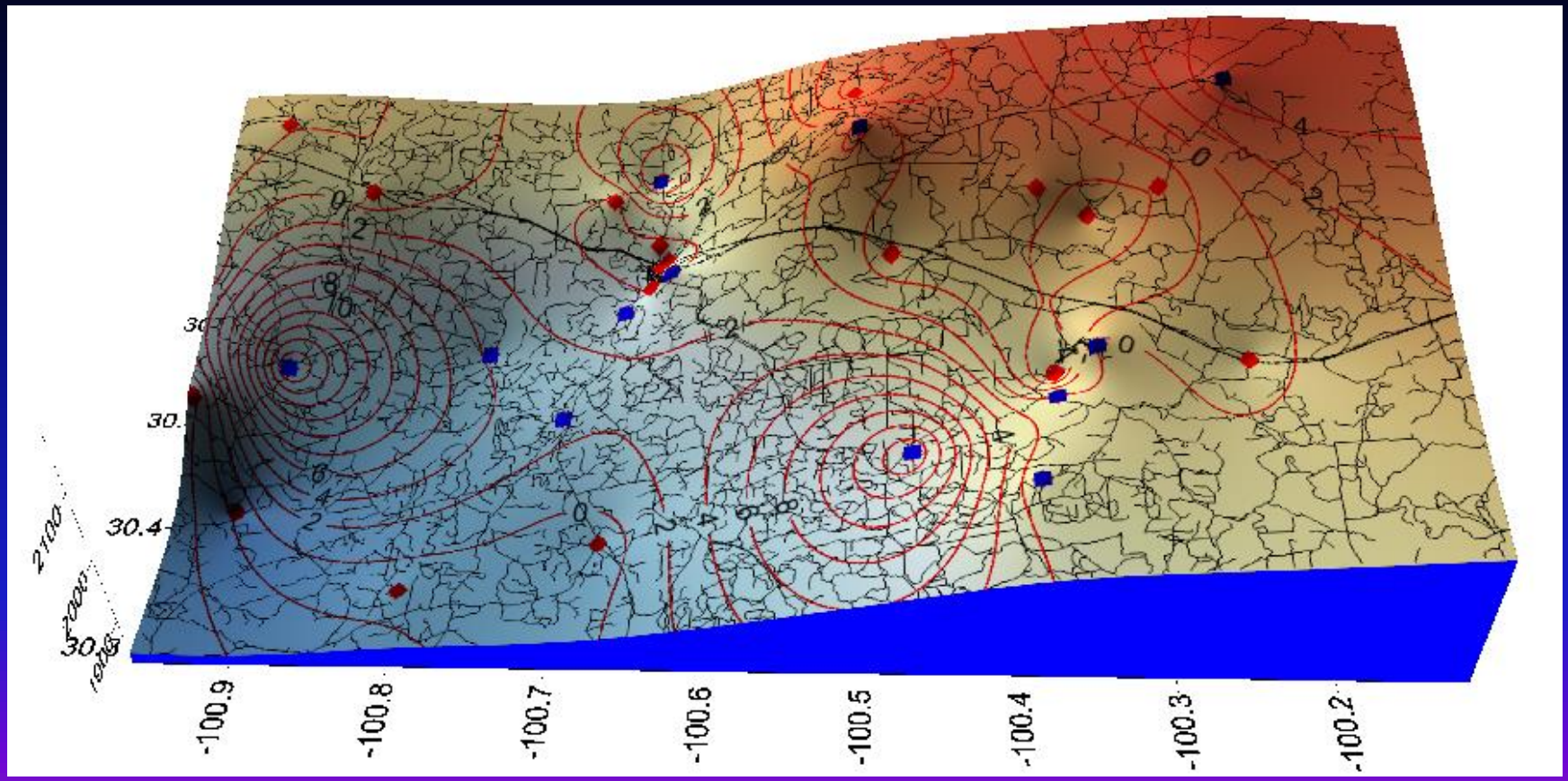


Potentiometric Surface Map (aquifer contour)

Map of Sutton County

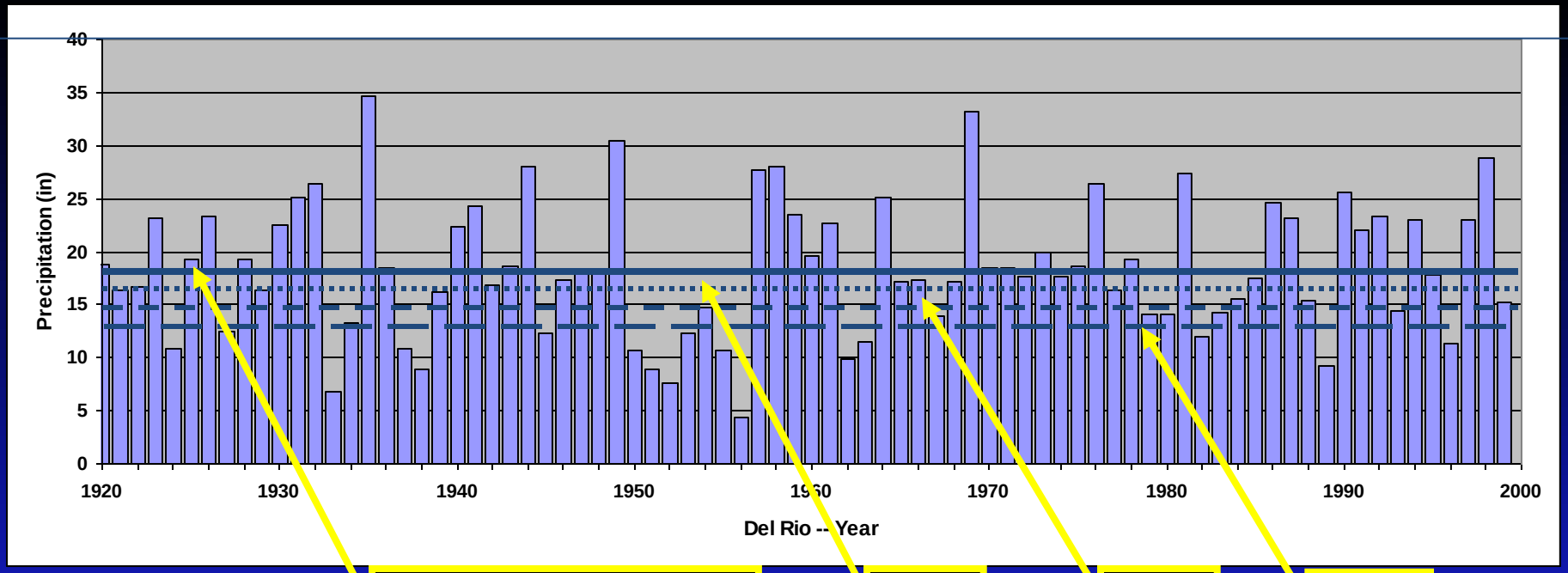


Example of Potentiometric Map Three Dimensional

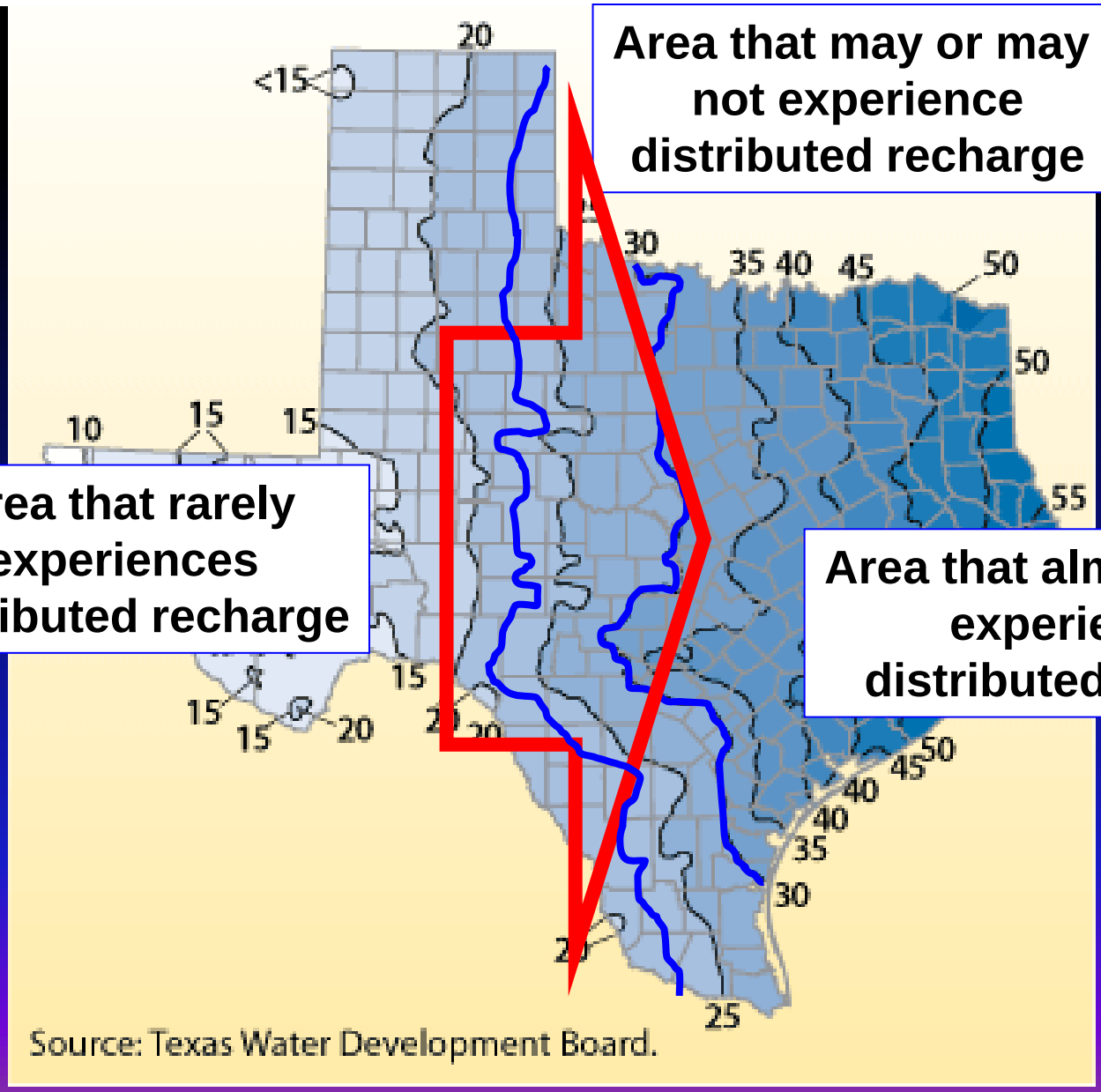


Rainfall/Drought Conditions

High variability in average annual precipitation
Del Rio, Texas (inch/year) (1920 to 2000)



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



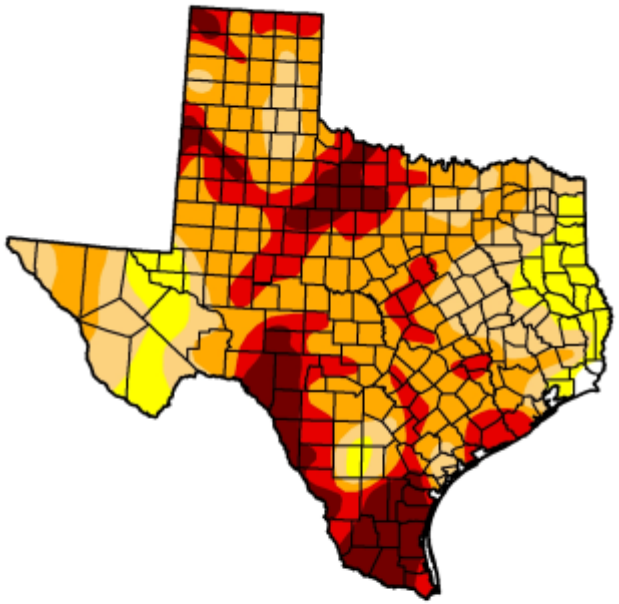
U.S. Drought Monitor

April 9, 2013
Valid 7 a.m. EST

Texas

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.44	99.56	89.44	69.35	29.91	11.56
Last Week (04/02/2013 map)	1.40	98.60	88.21	65.44	32.95	11.81
3 Months Ago (01/08/2013 map)	4.29	95.71	83.78	65.85	34.79	11.41
Start of Calendar Year (01/01/2013 map)	3.04	96.96	87.00	65.39	35.03	11.96
Start of Water Year (09/25/2012 map)	9.13	90.87	78.73	57.41	24.91	5.18
One Year Ago (04/03/2012 map)	16.55	83.45	65.39	53.08	34.81	14.05



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu

Released Thursday, April 11, 2013
David Miskus, NOAA/NWS/NCEP/Climate Prediction Center

Drought Contingency Plan

Drought Contingency Plan

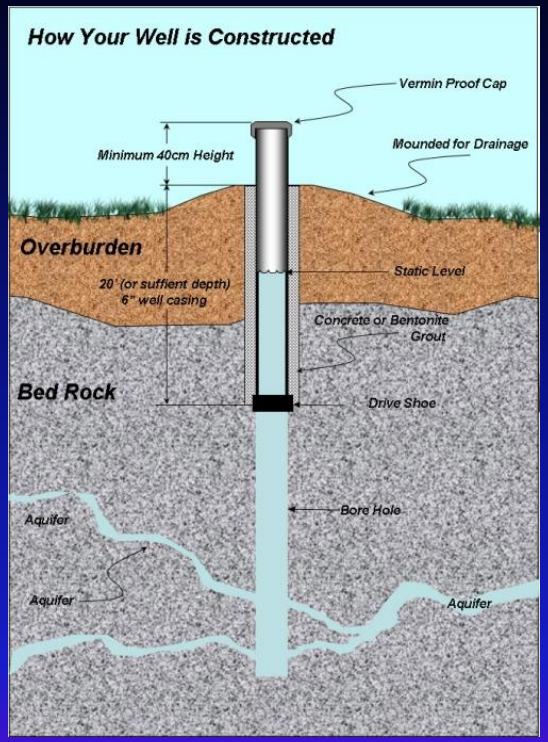
- Goal: Cause a reduction in water use in response to drought or emergency conditions
- Board of Directors and General Manager are responsible for the Plan
- Applies to:
  - City of Sonora
  - County of Sutton

Drought Contingency Plan (contd.)

- Drought stages are to be placed in effect by drought stage triggers
- Conditions to be monitored:
  - Drawdown reports
  - Rainfall
  - Water in storage
  - Water levels in the drought index well
  - Drought monitor indices

Drought Contingency Plan

Drought Index Well



Drought Stage Triggers

Drought Trigger	Drought Stage	Aquifer Level
0	Normal	1986.0 msl*
D0	Abnormally Dry	1984.5msl
D1	Moderate Drought	1983.0msl
D2	Severe Drought	1981.5 msl
D3	Extreme Drought	1980.0 msl
D4	Exceptional Drought	1978.5 msl

- * msl = mean sea level

Drought Contingency Plan

- District recognizes the City as responsible entity that manages and administers water resources of its citizens
- City is held responsible for adherence to the various stages of drought severity during drought conditions
- District is responsible for ensuring landowners in the County adhere to the various stages of drought severity during drought conditions

Drought Contingency Plan

- Penalties for violations
  - 1st violation – written notice
  - Failure to comply with Stage 1 $250/violation/day
  - Failure to comply with Stage 2 $500/violation/day
  - Failure to comply with Stage 3 $1,600/violation/day
  - Failure to comply by Stage 4 or 5 may assess $2,500/day
  - Subsequent violations may be assessed up to $10,000/day

Transportation Rule

Transportation Rule

- Permit required to transport groundwater beyond the boundaries of the District
- Application must be filed prior to beginning construction on any facilities to transport water
- Application must be administratively complete
- Board reserves the right to approve application

Transportation Rule

- Factors affecting approval:
  - Aquifer conditions, depletion, subsidence, effects on existing permit holders
  - Approved Regional Plan, District Management Plan, approved desired future conditions
  - Applications may only be approved for amount below sustainable yuield of the aquifer
  - Proposed use will not constitute waste

Transportation Rule

- This rule contains information required in the application
- There is a permit evaluation
- A notice of a public hearing on the application must be filed
- Public hearing on the application
- Monitoring and reporting requirements/responsibilities

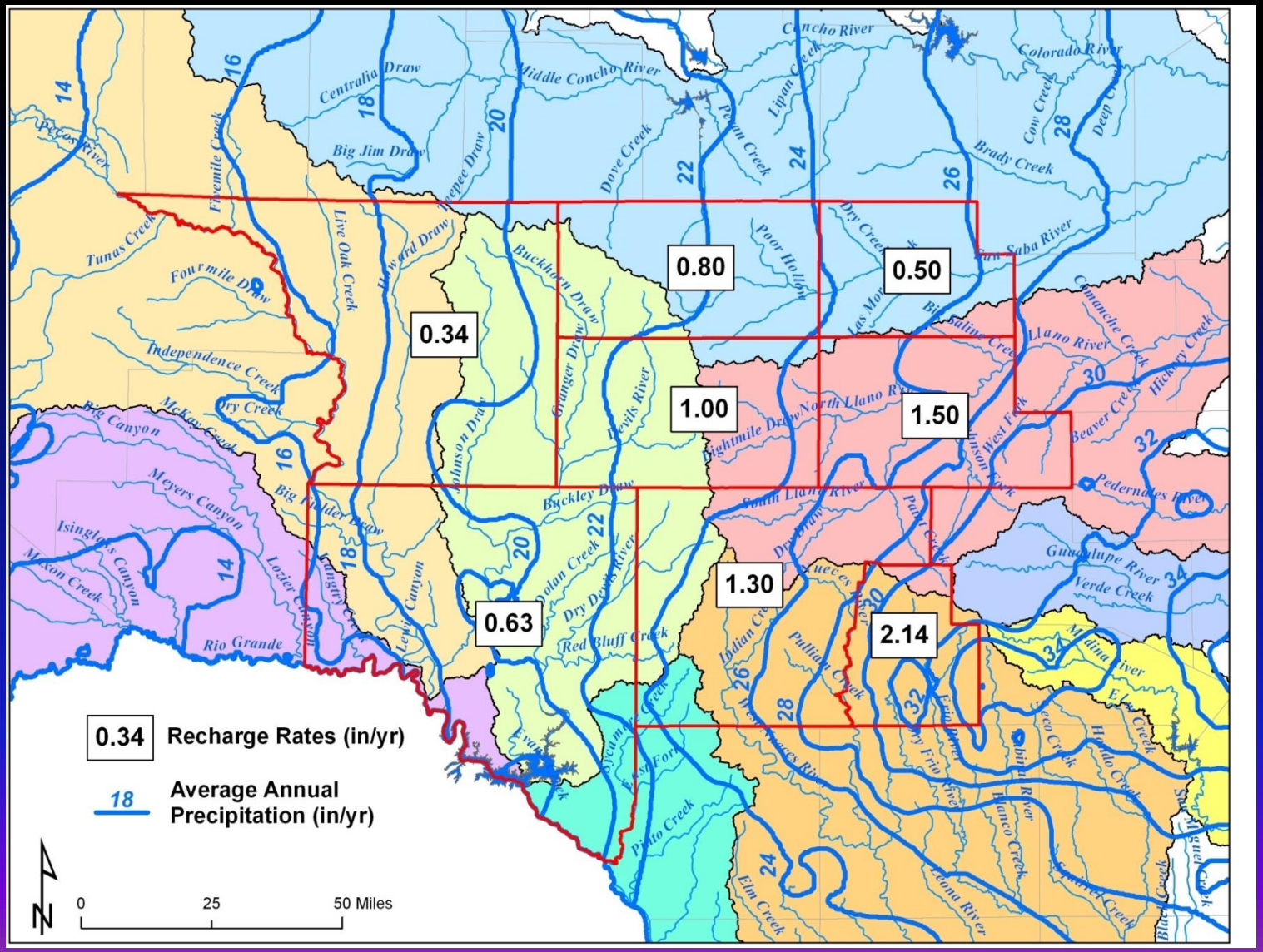

The End

Sutton County UWCD
301 S. Crockett Ave.
Sonora, TX 76950
(325) 387-2369
E-mail: sutuwcd7@verizon.net
Jim Polonis
General Manager

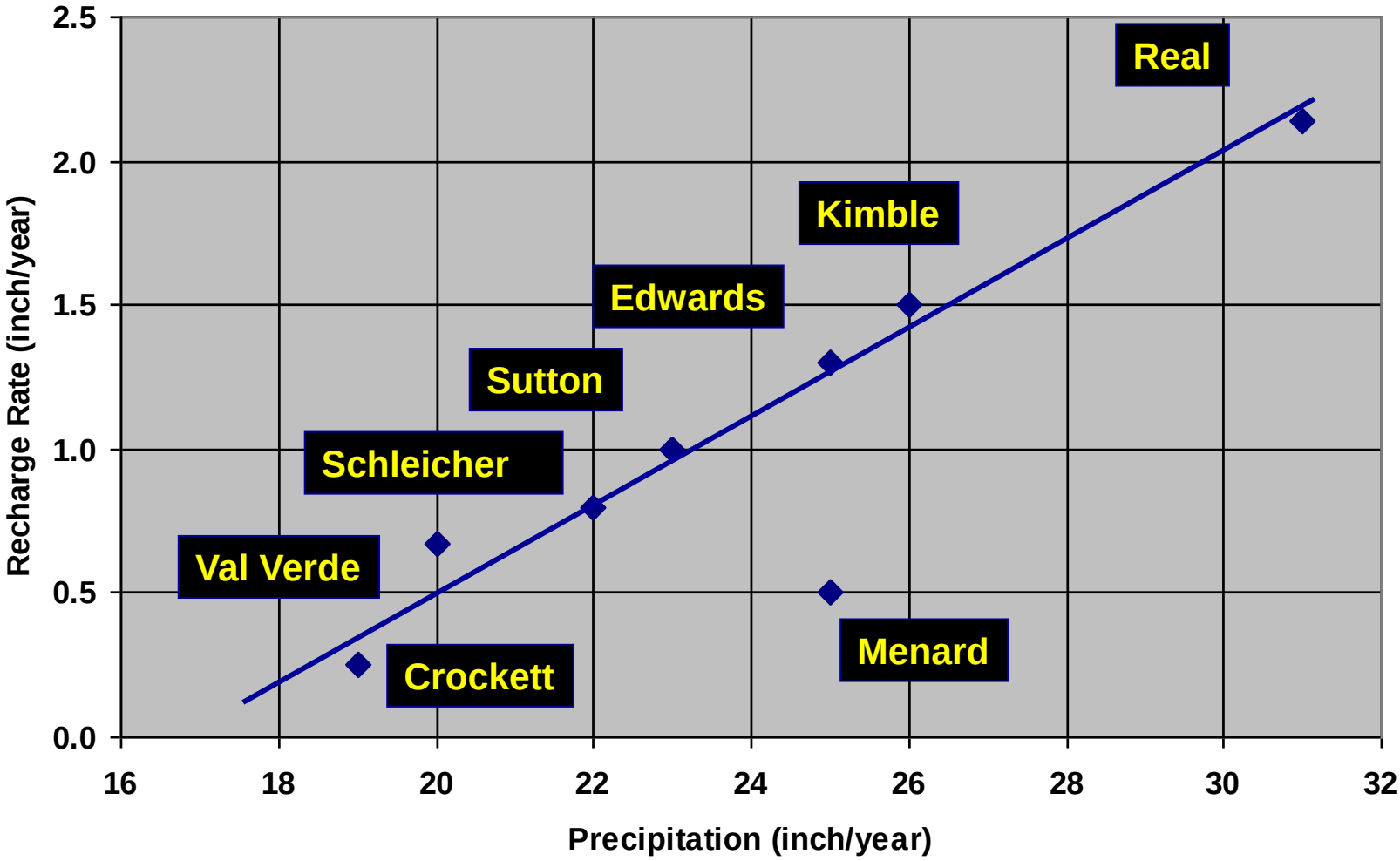
Background of Recharge Assessment

- Population in Texas is projected to increase by 50% in 50 yrs
- Urban areas increasingly look to rural areas for increased water resources, some of these areas are in arid and semi-arid climates
- Studies in west-central Texas indicate that distributed recharge decreases to zero when precipitation decreases below about 15-17 in/yr
- Precipitation, and recharge, are highly variable in regions on the cusp of being semi-arid and arid
- Consequently, recharge can be negligible during years of drought
- Water resource management should be predicated on average drought conditions, not average conditions unless large-scale storage is available

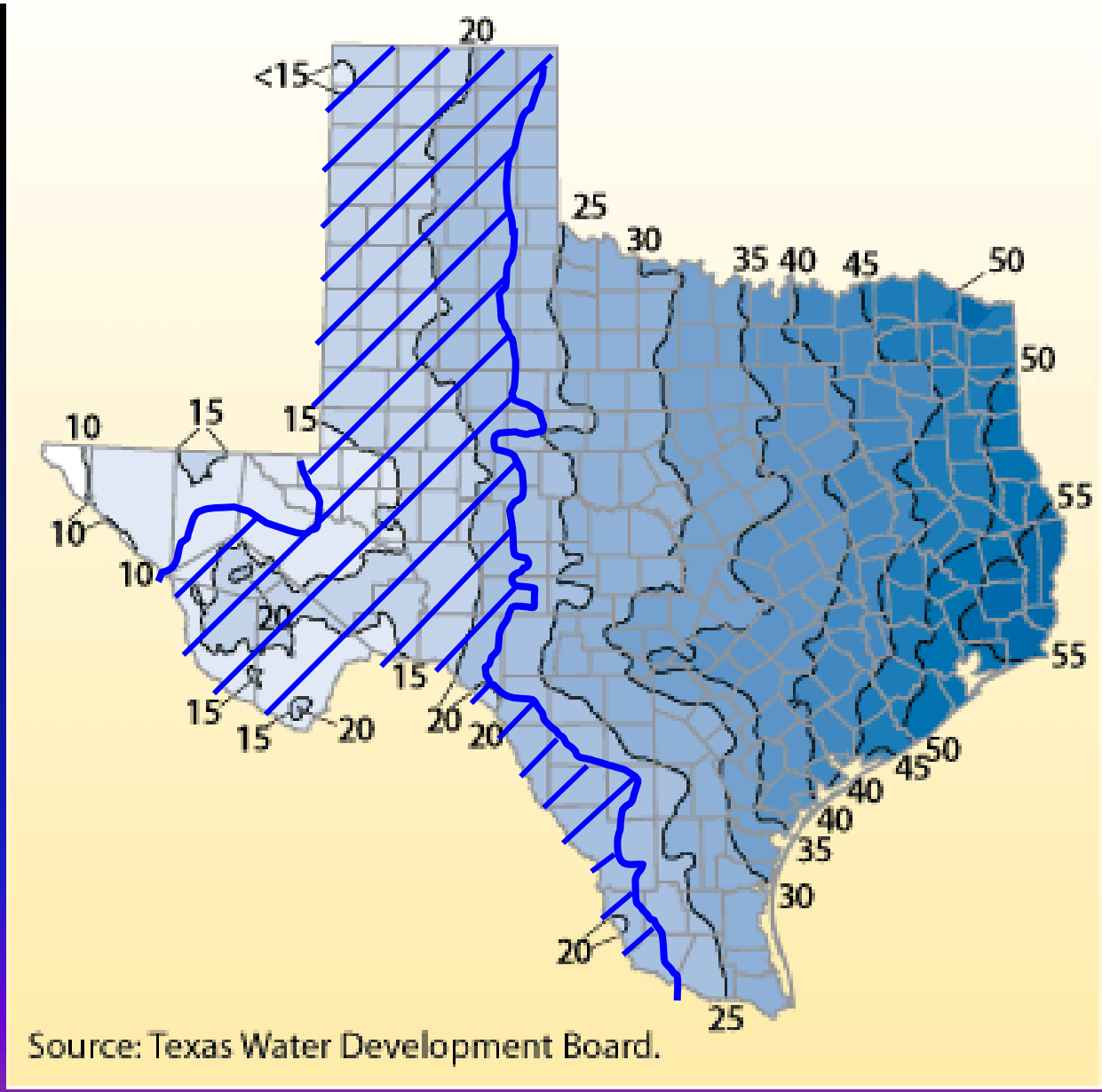
Recharge rates in study area corrected for actual groundwater catchment areas



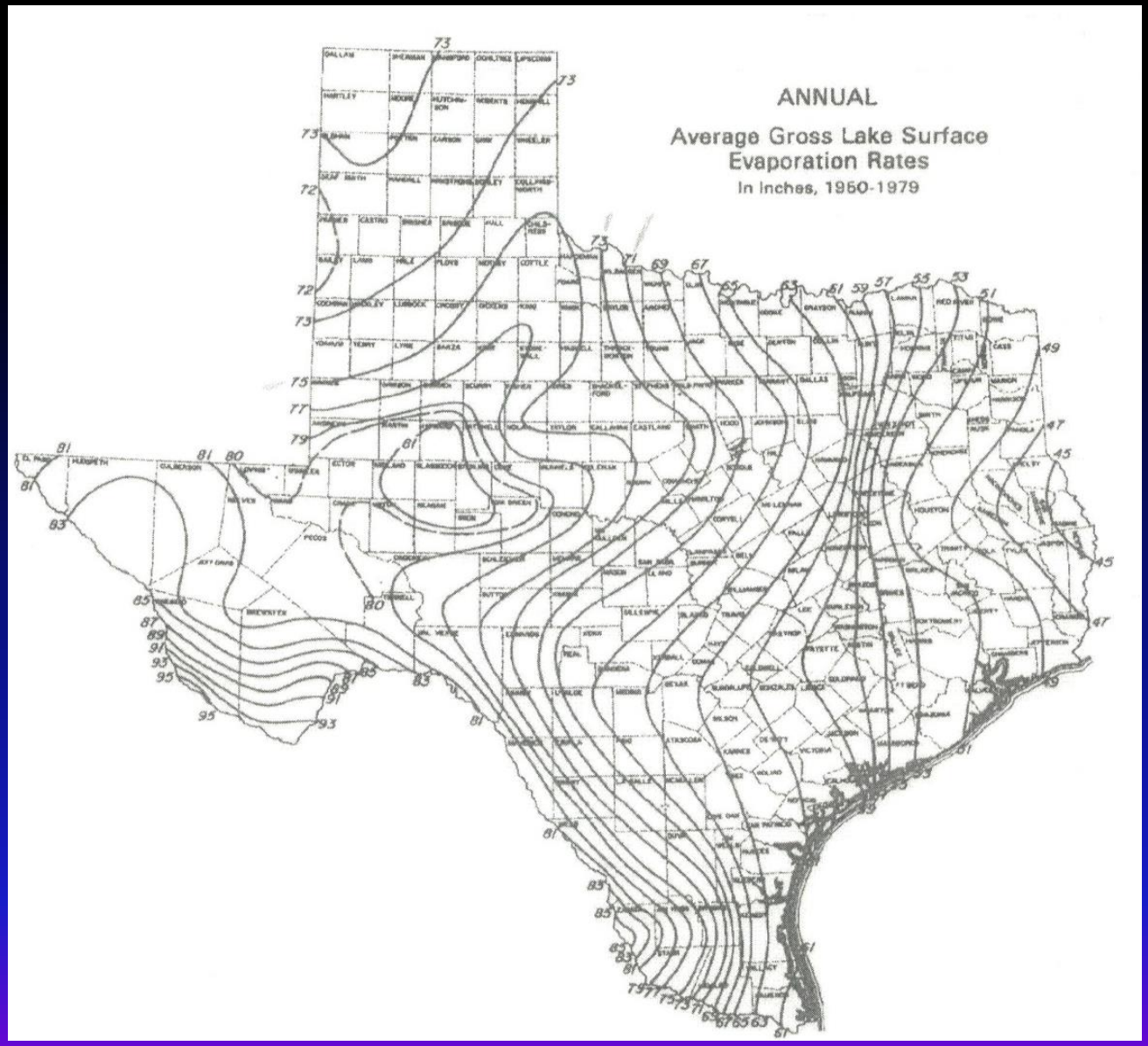
Recharge is minimal when precipitation is less than 20 inch/year



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



Source: Texas Water Development Board.


ANNUAL
Average Gross Lake Surface
Evaporation Rates
In Inches, 1950-1979

PRECIPITATION SUMMARY DATA

Quad Number:	707		
Years of Data:	70		
Driest Year:	1952	9.17	inches
Wettest Year:	2004	36.57	inches
Wettest Month:	AUG	1998	10.81 inches
Historically Wettest Month:	May	2.78	inches
Historically Driest Month:	December	0.98	inches
Average Year:	22.69	inches	

Historic Consecutive Months W/O Precipitation: 2

Historically Driest Months and Probability of Being Dry:	
NOV	12.9%
DEC	11.4%
JAN	7.1%
FEB	5.7%
MAR	4.3%
OCT	2.9%
JUN	1.4%
JUL	1.4%
APR	0.0%
MAY	0.0%
AUG	0.0%
SEP	0.0%

Historic Probability of Any Given Month Being Dry: 3.9%

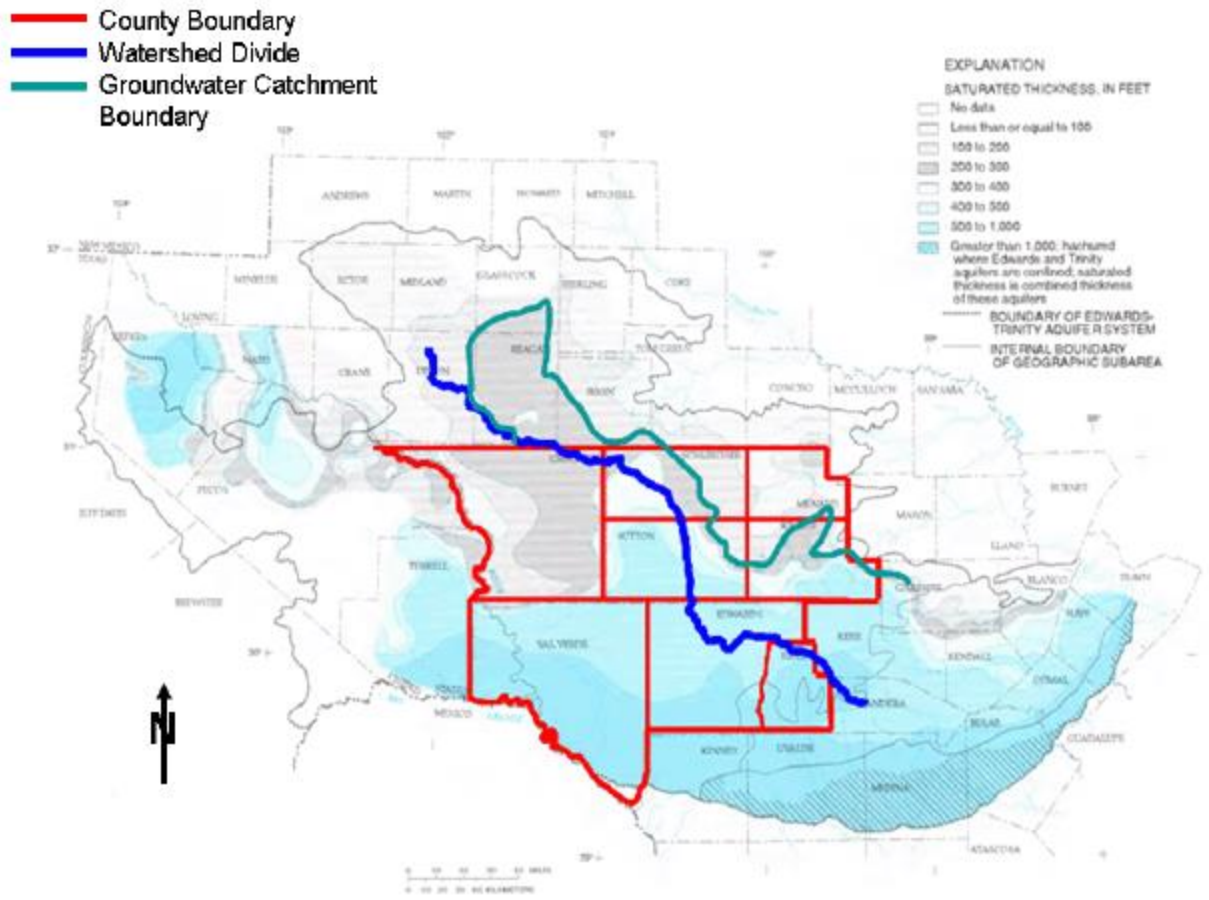
EVAPORATION SUMMARY DATA

Quad Number:	707		
Years of Data:	56		
Most Evaporation (Annual):	1964	79.84	inches
Least Evaporation (Annual):	2004	46.05	inches
Historic Month with Most Evap:	July	8.52	inches
Historic Month with Least Evap:	January	2.48	inches
Average Evaporation (Annual):	61.94	inches	
Most Net Evaporation (Annual):	1963	62.19	inches
Least Net Evaporation (Annual):	2004	9.49	inches
Probability of Net Evaporation:		100.0	%
Probability of Surplus Precipitation:		0.0	%
Average Net Evaporation (Annual):		38.4	inches

Minimum Runoff to Maintain Desired Water Level:
3.20 ac-feet

HISTORIC MONTHLY AVERAGES

Month	Precipitation	Evaporation
January	1.06 inches	2.48 inches
February	1.27 inches	2.88 inches
March	1.32 inches	4.65 inches
April	1.95 inches	5.75 inches
May	2.78 inches	6.00 inches
June	2.62 inches	7.31 inches
July	1.90 inches	8.52 inches
August	2.45 inches	7.91 inches
September	2.62 inches	5.85 inches
October	2.46 inches	4.68 inches
November	1.28 inches	3.21 inches
December	0.98 inches	2.57 inches


County Boundary
Watershed Divide
Groundwater Catchment Boundary
EXPLANATION
SATURATED THICKNESS, IN FEET
No data
Less than or equal to 100
100 to 200
200 to 300
300 to 400
400 to 500
500 to 1,000
Greater than 1,000; hachured where Edwards and Trinity aquifers are confined; saturated thickness is combined thickness of these aquifers
BOUNDARY OF EDWARDS-TRINITY AQUIFER SYSTEM
INTERNAL BOUNDARY OF GEOGRAPHIC SUBAREA
N

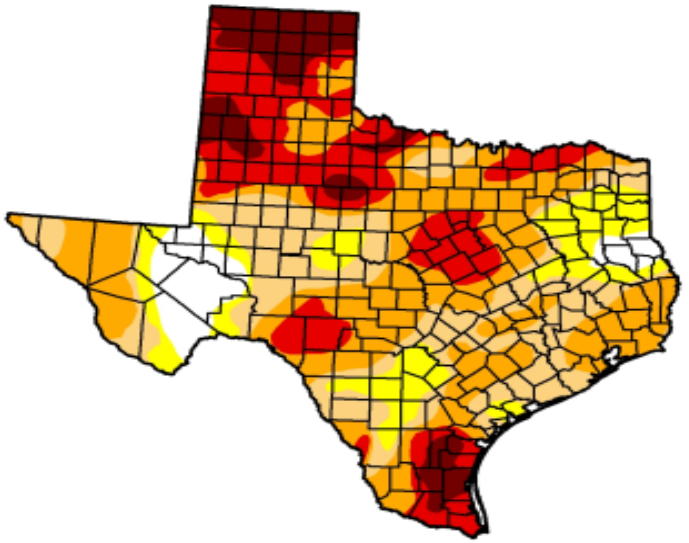
U.S. Drought Monitor

December 4, 2012
Valid 7 a.m. EST

Texas

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	6.16	93.84	82.20	59.27	27.40	8.45
Last Week (11/27/2012 map)	6.16	93.84	80.51	54.47	24.50	7.63
3 Months Ago (09/04/2012 map)	10.31	89.69	72.40	44.20	21.13	3.57
Start of Calendar Year (12/27/2011 map)	0.01	99.99	97.83	84.81	67.32	32.36
Start of Water Year (09/25/2012 map)	9.13	90.87	78.73	57.41	24.91	5.18
One Year Ago (11/29/2011 map)	0.00	100.00	100.00	94.23	82.66	52.67



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

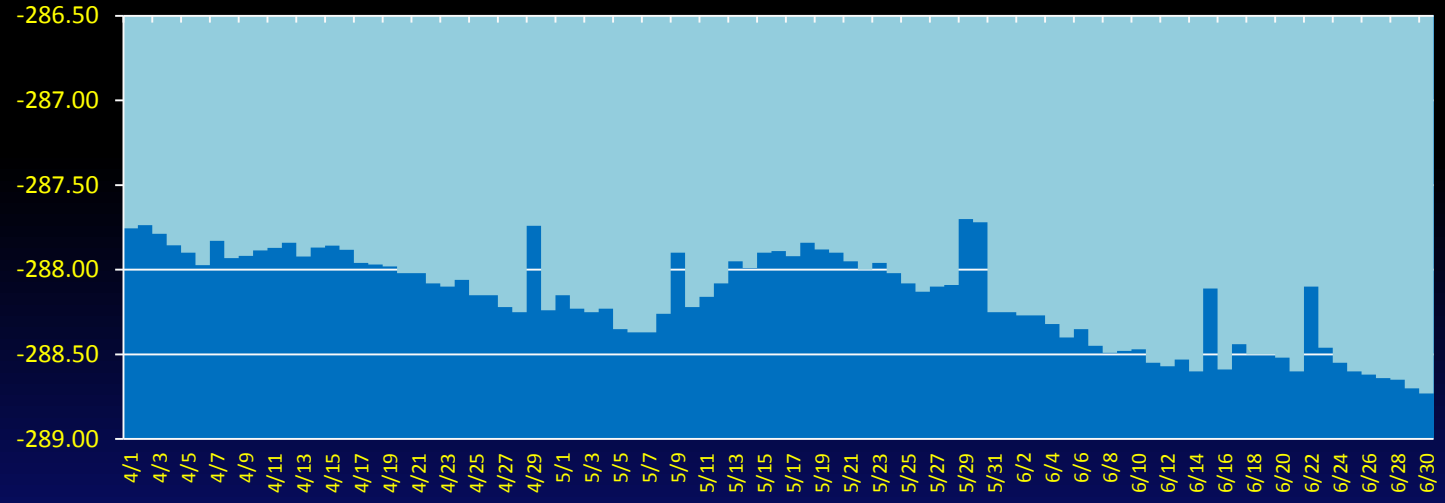
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu

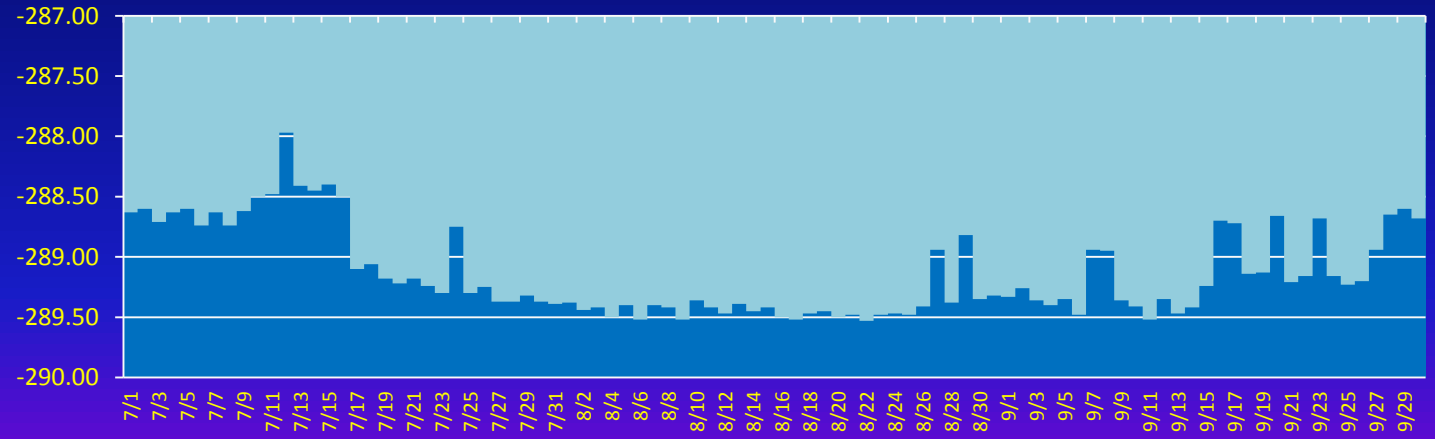
USDA National Drought Mitigation Center

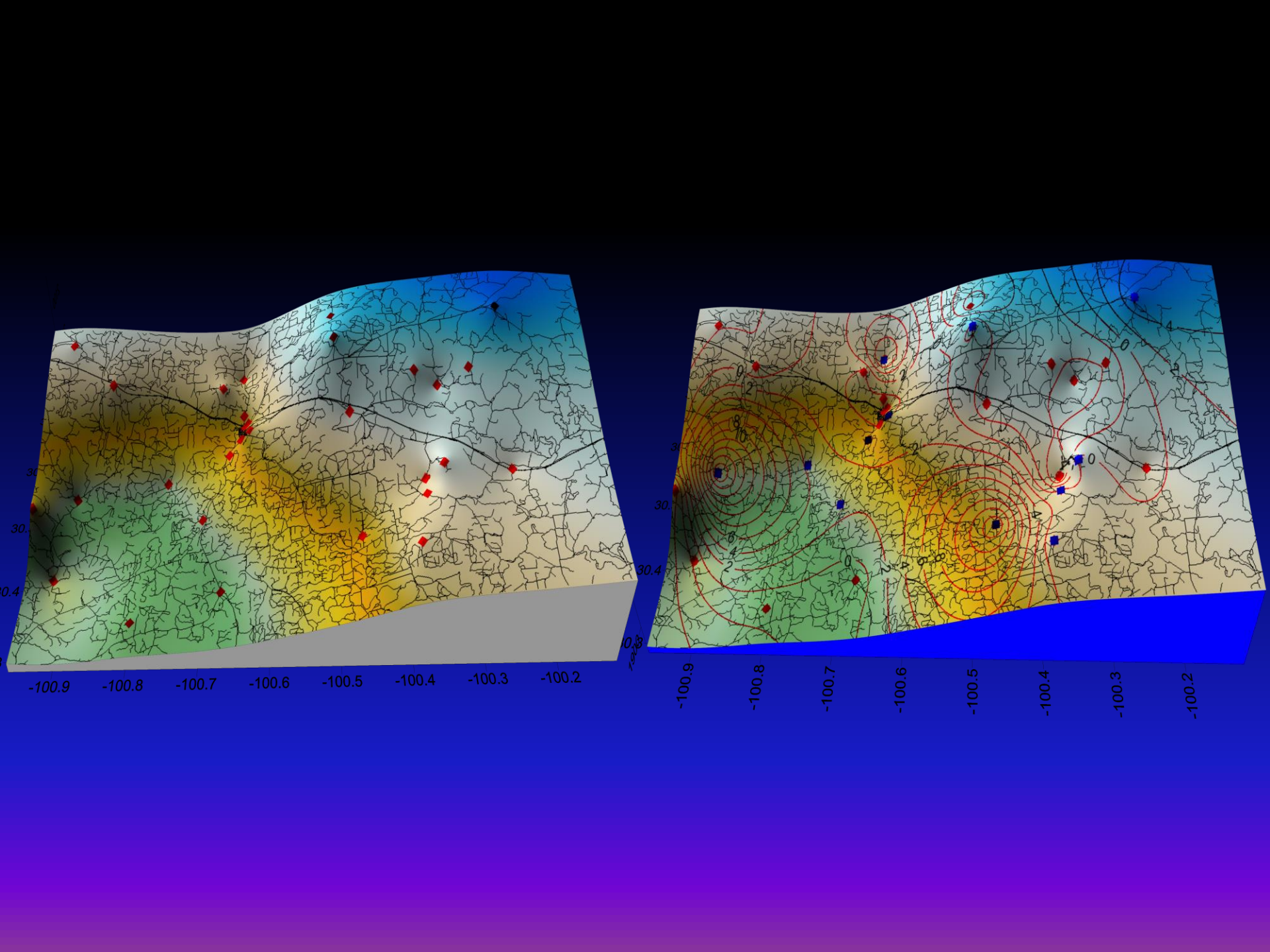
Released Thursday, December 6, 2012
Richard Tinker, NOAA/CPC

City Well #3 55-27-603 2nd Qtr. 2012 SN#: 194924
Level Surface Elevation (ft)



City Well #3 55-27-603 3rd Qtr. 2012 SN#: 194924
Level Surface Elevation (ft)




-100.9
-100.8
-100.7
-100.6
-100.5
-100.4
-100.3
-100.2
30.4
0
2
4
6
8
10

Drought Trigger/Stage Levels

Drought Trigger	Drought Stage	Aquifer Level
0	Wet Year Normal	1986.5 msl*
D0	Abnormally Dry	1986.0 msl
D1	Moderate Drought	1985.5 msl
D2	Severe Drought	1985.0 msl
D3	Extreme Drought	1984.5 msl
D4	Exceptional Drought	1984.0 msl

* msl = mean sea level

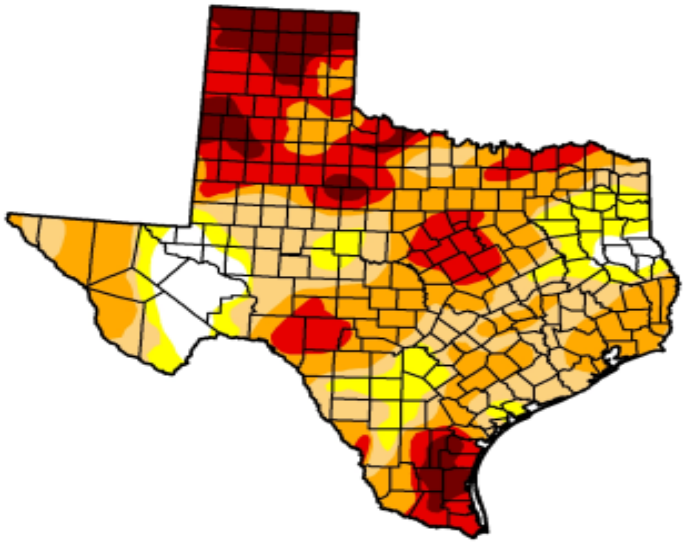
U.S. Drought Monitor

December 4, 2012
Valid 7 a.m. EST

Texas

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	6.16	93.84	82.20	59.27	27.40	8.45
Last Week (11/27/2012 map)	6.16	93.84	80.51	54.47	24.50	7.63
3 Months Ago (09/04/2012 map)	10.31	89.69	72.40	44.20	21.13	3.57
Start of Calendar Year (12/27/2011 map)	0.01	99.99	97.83	84.81	67.32	32.36
Start of Water Year (09/25/2012 map)	9.13	90.87	78.73	57.41	24.91	5.18
One Year Ago (11/29/2011 map)	0.00	100.00	100.00	94.23	82.66	52.67



Intensity:

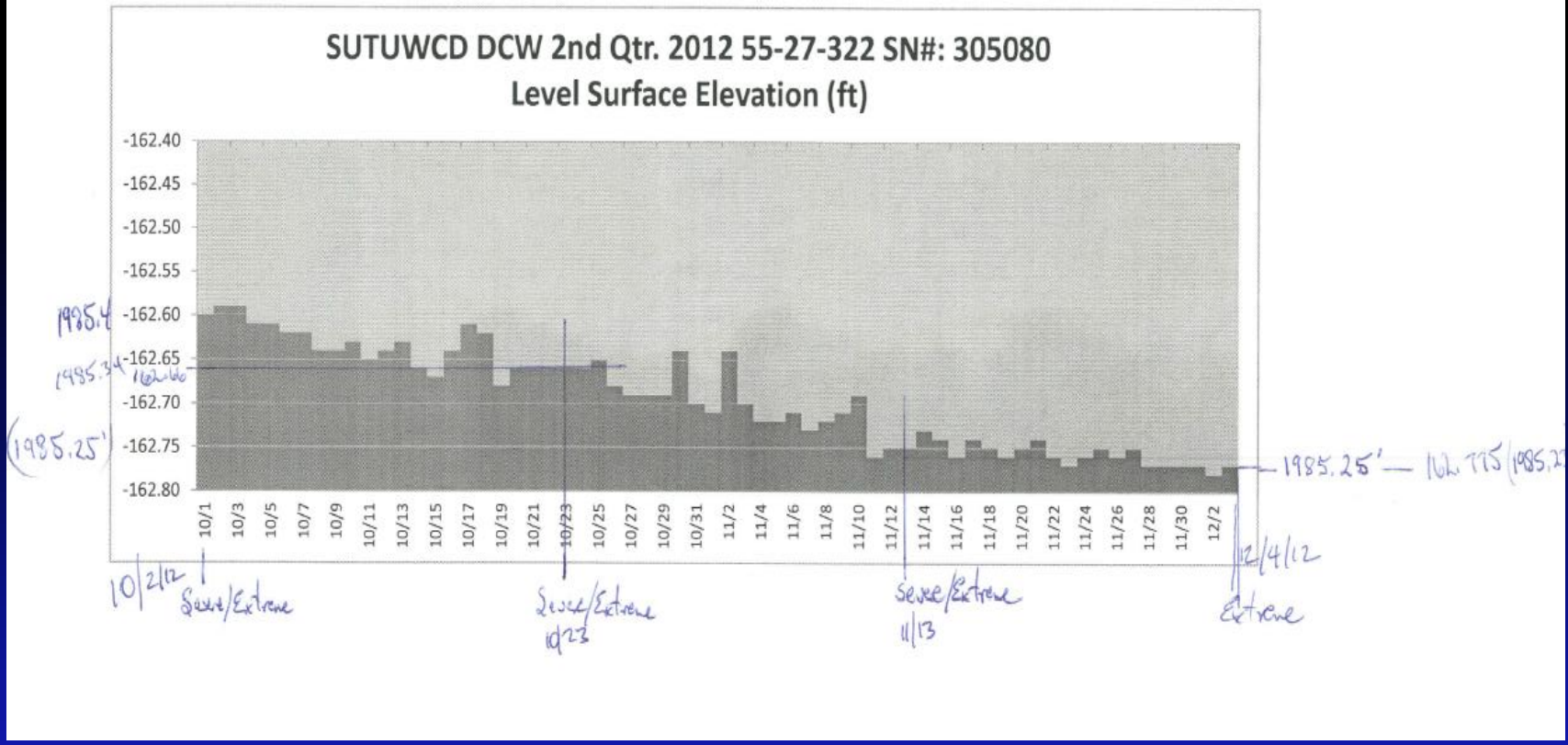
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

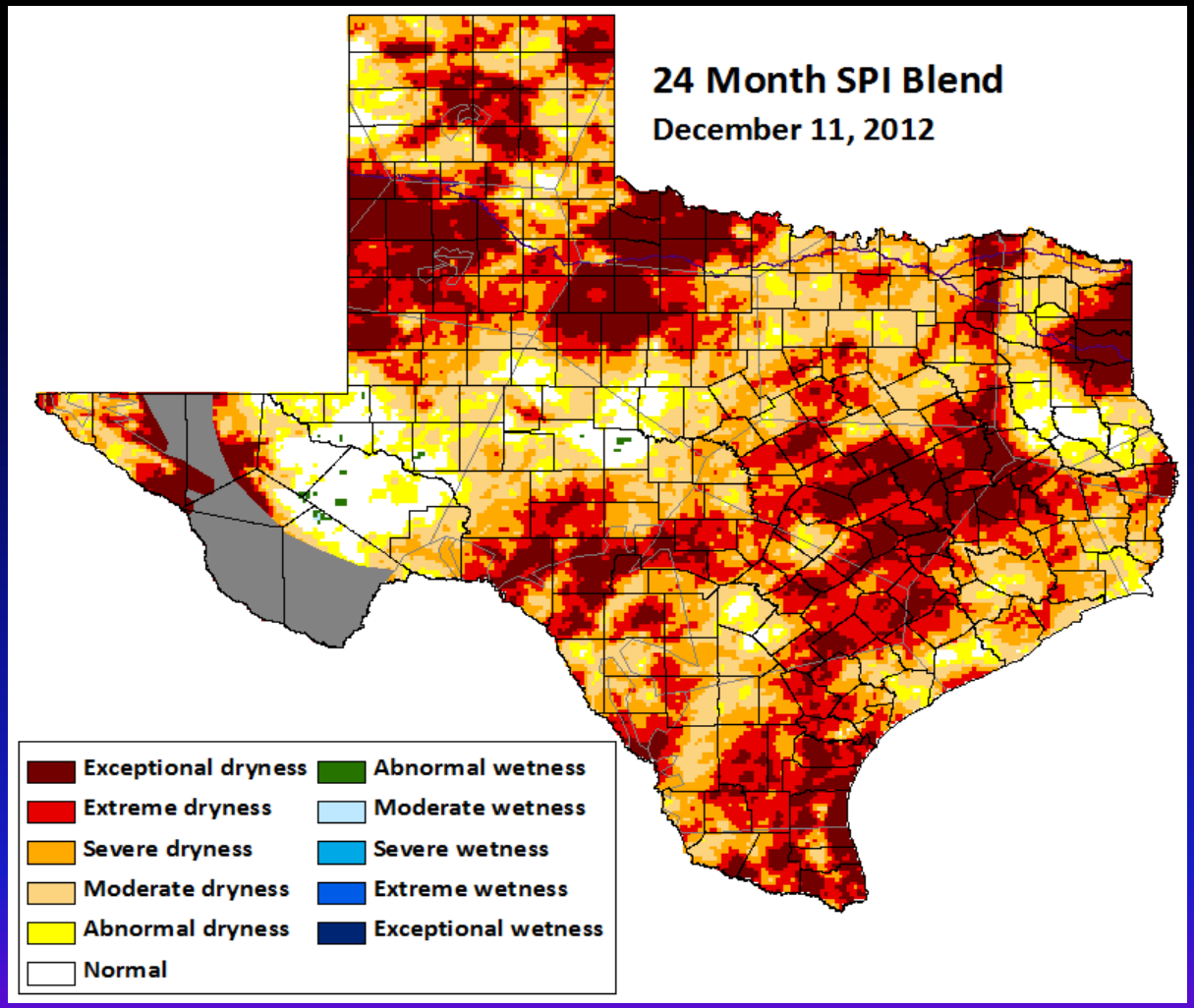
http://droughtmonitor.unl.edu

USDA National Drought Mitigation Center

Released Thursday, December 6, 2012
Richard Tinker, NOAA/CPC


SUTUWCD DCW 2nd Qtr. 2012 55-27-322 SN#: 305080
Level Surface Elevation (ft)
-162.40
-162.45
-162.50
-162.55
-162.60
-162.65
-162.70
-162.75
-162.80
10/1
10/3
10/5
10/7
10/9
10/11
10/13
10/15
10/17
10/19
10/21
10/23
10/25
10/27
10/29
10/31
11/2
11/4
11/6
11/8
11/10
11/12
11/14
11/16
11/18
11/20
11/22
11/24
11/26
11/28
11/30
12/2
1985.4
1985.34
(1985.25')
1985.25'
10/2/12
Severe/Extreme
Severe/Extreme
10/23
Severe/Extreme
11/13
12/4/12
Extreme

Current Drought Conditions



Contact Information

- Ms. Rhonda Jolley

  Water District Attorney

  The Nunley Firm LLP

  Boerne, TX 78006

  (830) 816 3333

- Ron Green Ph.D., P.G.

  Institute Scientist

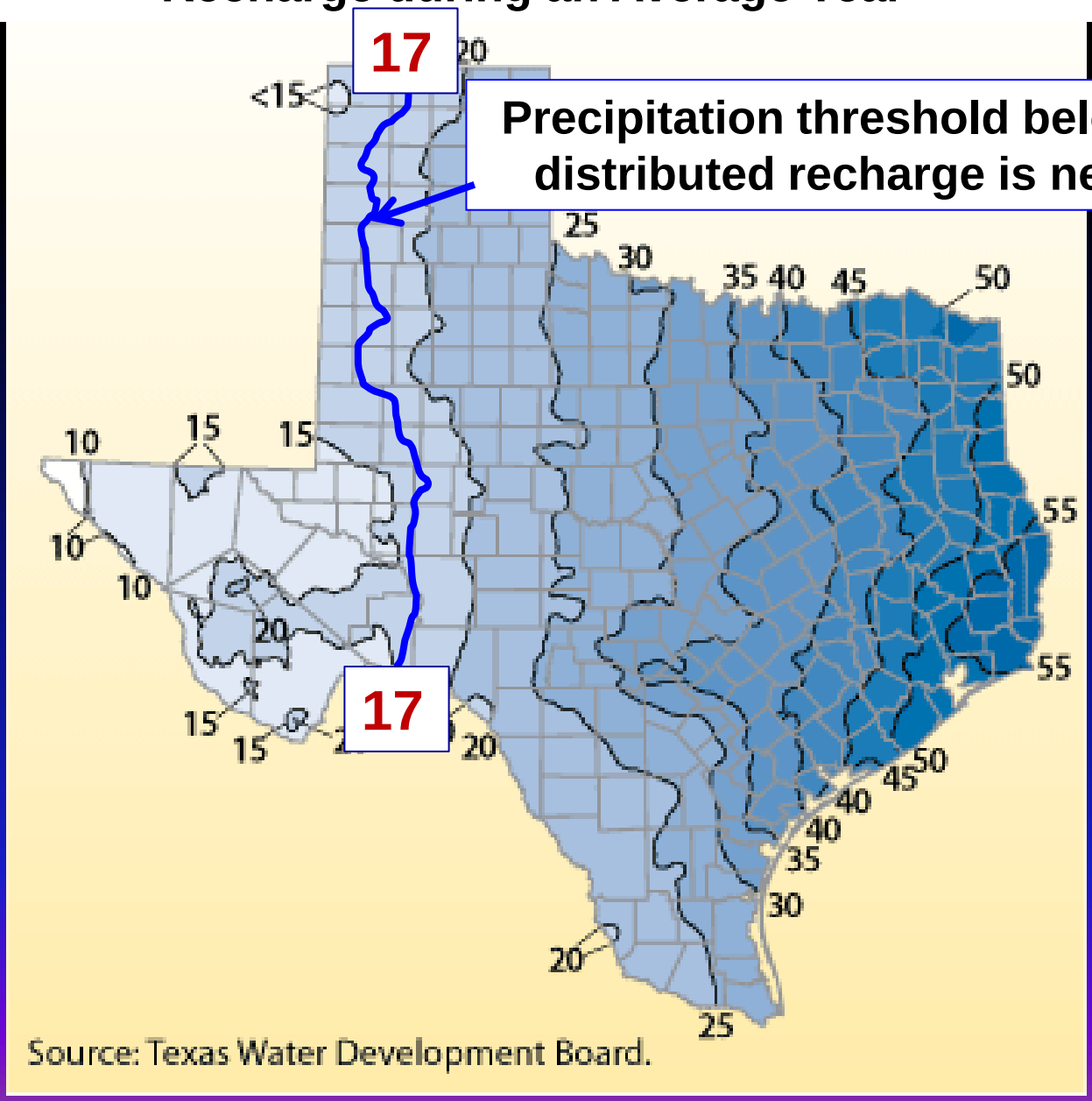
  Geoscience and Engineering Division

  Southwest Research Institute (SwRI)

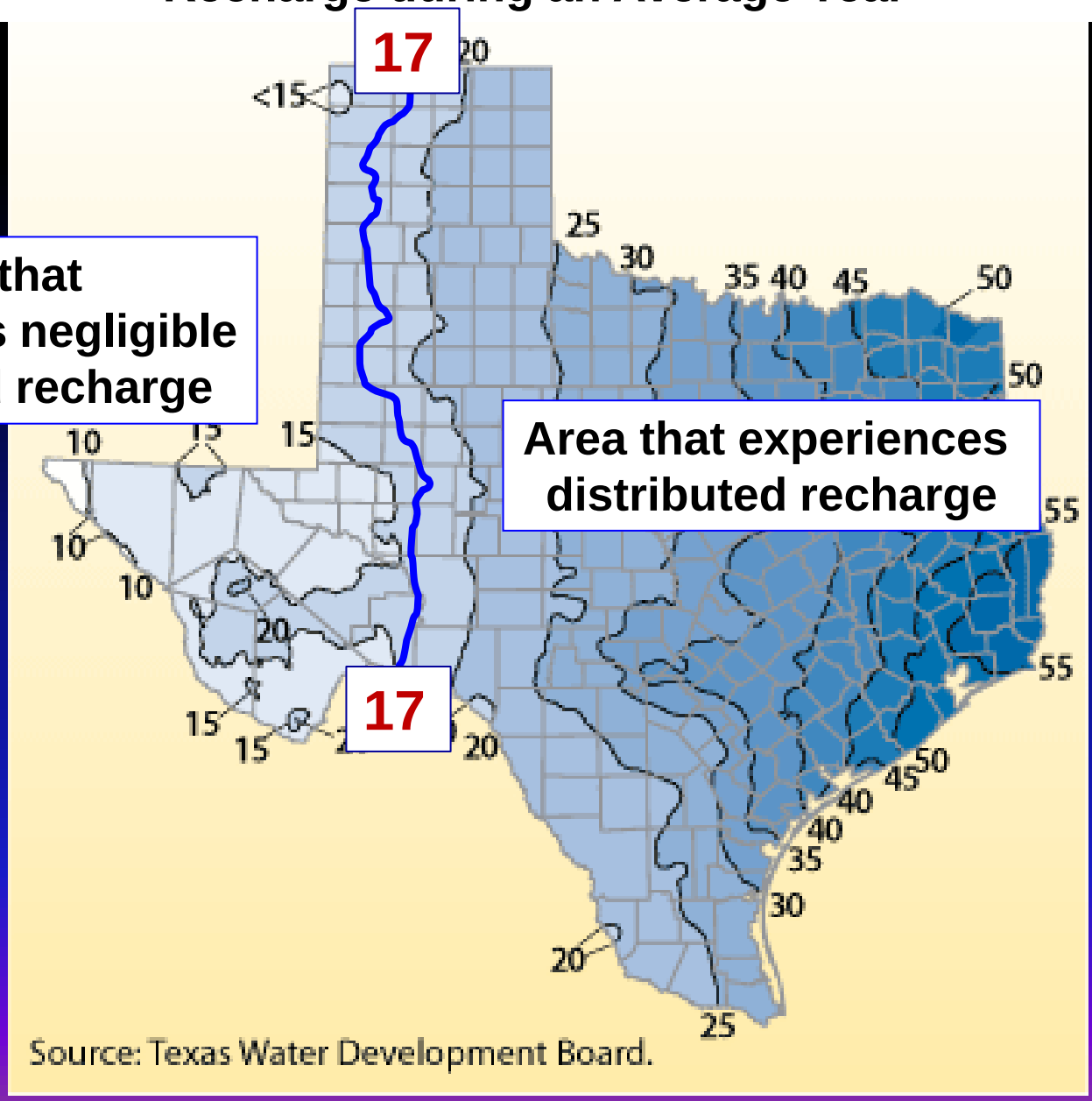
  San Antonio, TX

  (210) 522 -5305

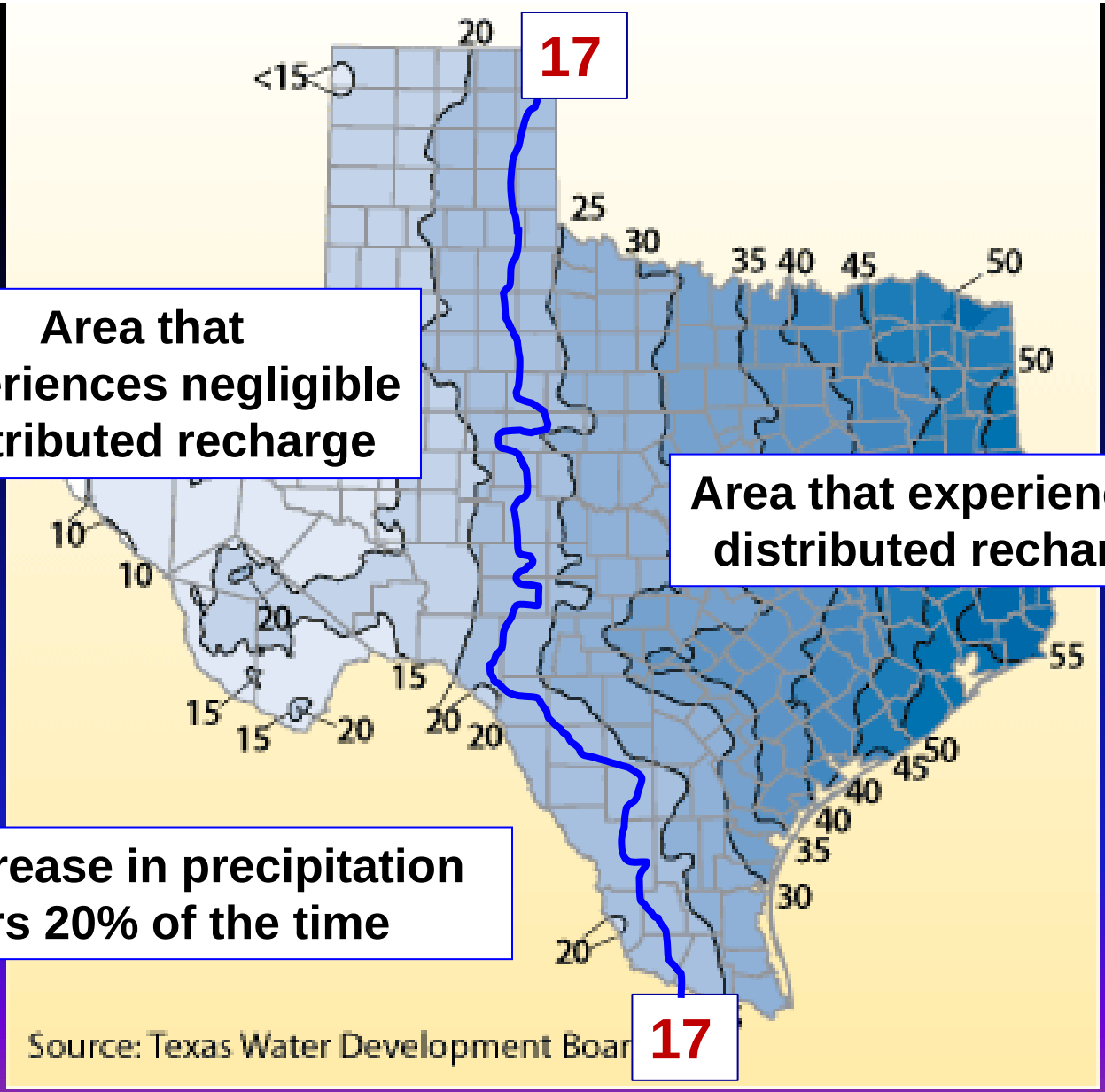
Western Texas Experiences Negligible Distributed Recharge during an Average Year



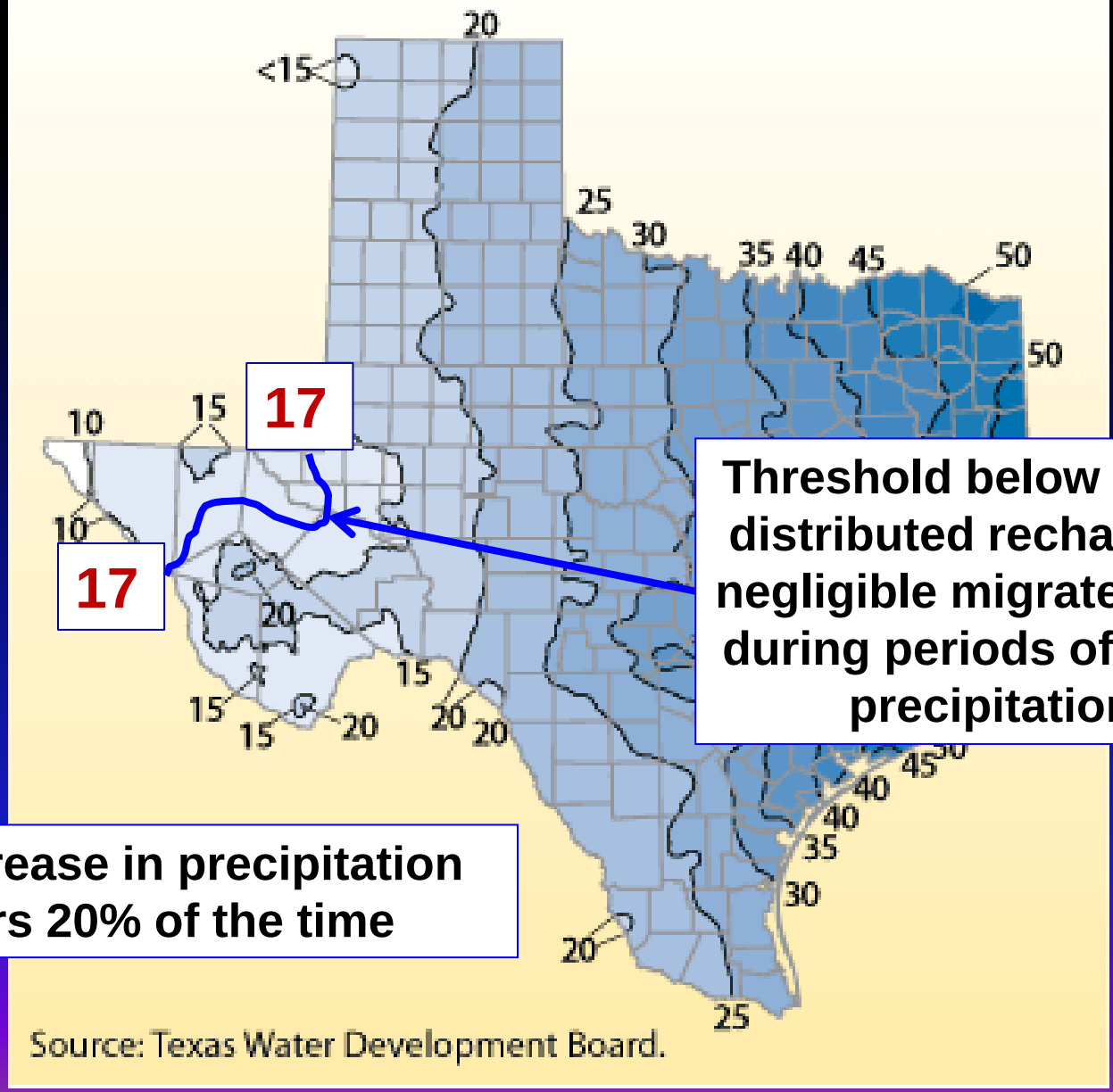
Western Texas Experiences Negligible Distributed Recharge during an Average Year



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



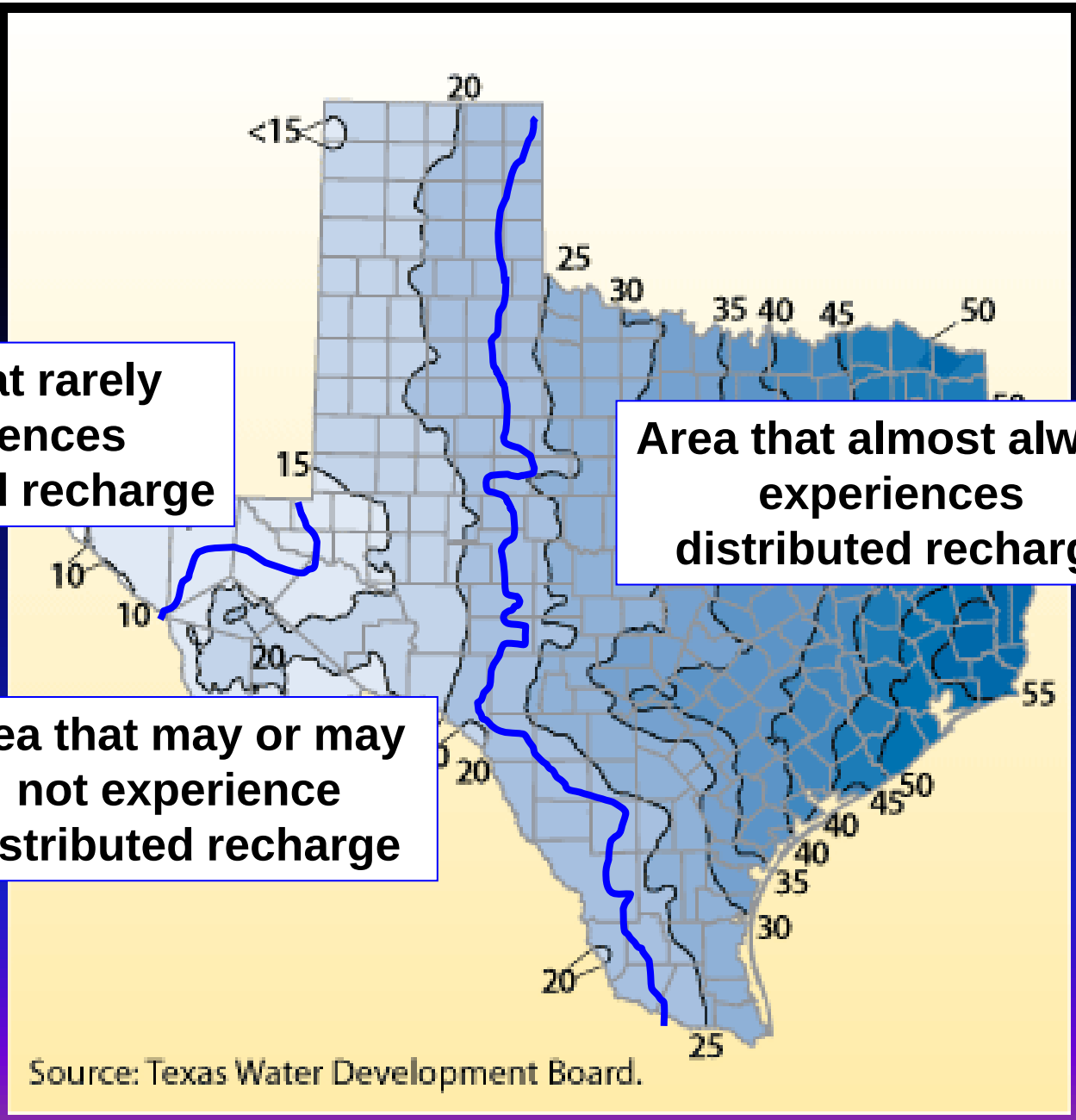
Greater Area Experiences Distributed Recharge during a Wet Year (30% increase)



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



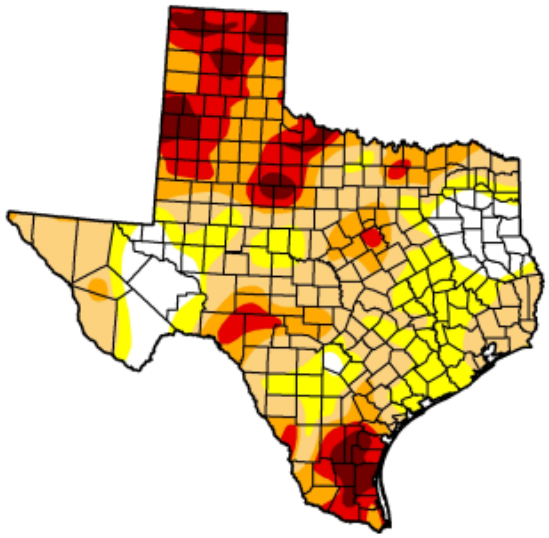
U.S. Drought Monitor

November 13, 2012
Valid 7 a.m. EST

Texas

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	10.54	89.46	69.59	36.99	18.92	6.12
Last Week (11/06/2012 map)	15.44	84.56	59.90	33.55	16.98	4.68
3 Months Ago (08/14/2012 map)	11.08	88.92	78.72	44.03	12.59	0.82
Start of Calendar Year (12/27/2011 map)	0.01	99.99	97.83	84.81	67.32	32.36
Start of Water Year (09/25/2012 map)	9.13	90.87	78.73	57.41	24.91	5.18
One Year Ago (11/08/2011 map)	0.00	100.00	100.00	98.08	90.31	65.82



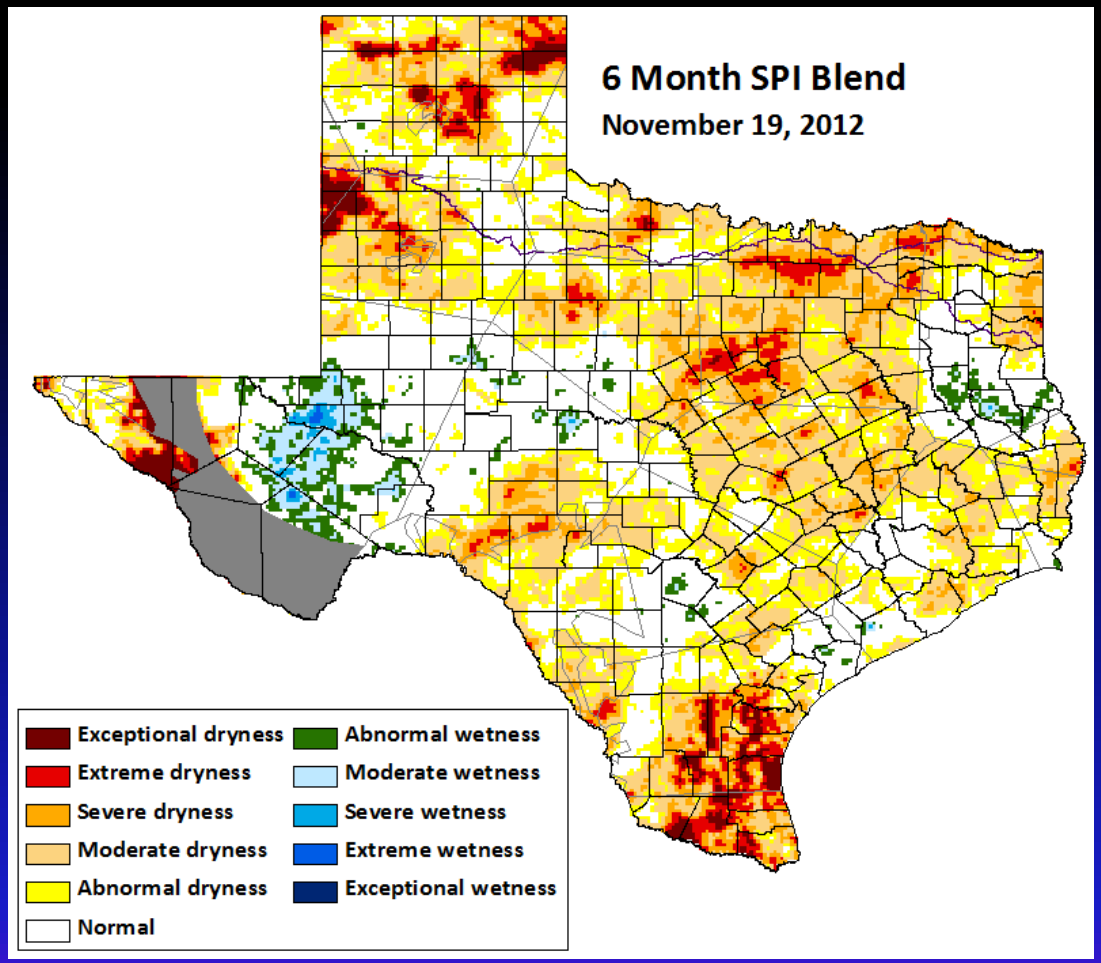
Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu

Released Thursday, November 15, 2012
David Miskus, Climate Prediction Center/NCEP/NWS/NOAA


6 Month SPI Blend
November 19, 2012
Exceptional dryness
Extreme dryness
Severe dryness
Moderate dryness
Abnormal dryness
Normal
Abnormal wetness
Moderate wetness
Severe wetness
Extreme wetness
Exceptional wetness

Desired Future Conditions (DFC)

Definition:

Desired Future Conditions (DFC) are the desired, quantified conditions of groundwater resources (such as water levels, water quality, spring flows, or volumes) at a specified time or times in the future or in perpetuity.

GCDs & DFCs

- GCDs must account for the water used within their respective districts to establish the DFC
- The accounting must be fair and balanced in order for the DFC to be equitable
- The water use data is collected by the district
- If all water use data is not made available then the DFC will be in error, consequently future water allocations will be incorrect, which could affect economic development

Examples of DFCs

- Water Levels do not decline more than 100' in 50 years
- Water quality is not degraded, in concentrations, *above* 1000 mg/L – Total Dissolved Solids in 50 years
- Spring flow does not fall below 10 ft^3/sec during drought of record
- 50% of water in storage will be available in 50 years

Preliminary Results (7/29/2010)
Edwards-Trinity (Plateau) and Pecos Valley Aquifer
Groundwater Model
(One Layer Model, GMA 7 Area Only)
Simulation for period 2006 to 2060
Drawdown in feet from 2010 Conditions

	Scenario 9	
County	Pumping (AF/yr)	Drawdown in 2060 (ft)
Coke	1,000	0
Concho	490	0
Crockett	5,475	9
Ector	5,534	7
Edwards	5,659	2
Gillespie	5,000	5
Glasscock	65,177	34
Irion	2,300	10
Kimble	1,400	1
Kinney	65,000	0
McCulloch	150	0
Mason	20	0
Menard	2,580	1
Midland	23,243	10
Nolan	700	0
Pecos	240,000	11
Reagan	68,243	37
Real	7,533	4
Schelicher	8,680	8
Sterling	2,500	6
Sutton	6,450	6
Taylor	490	0
Terrell	1,443	2
TomGreen	2,800	2
Upton	22,375	13
Uvalde	2,000	2
ValVerde	25,000	1
GMA 7	**571,242**	**7**

Average Annual Precipitation

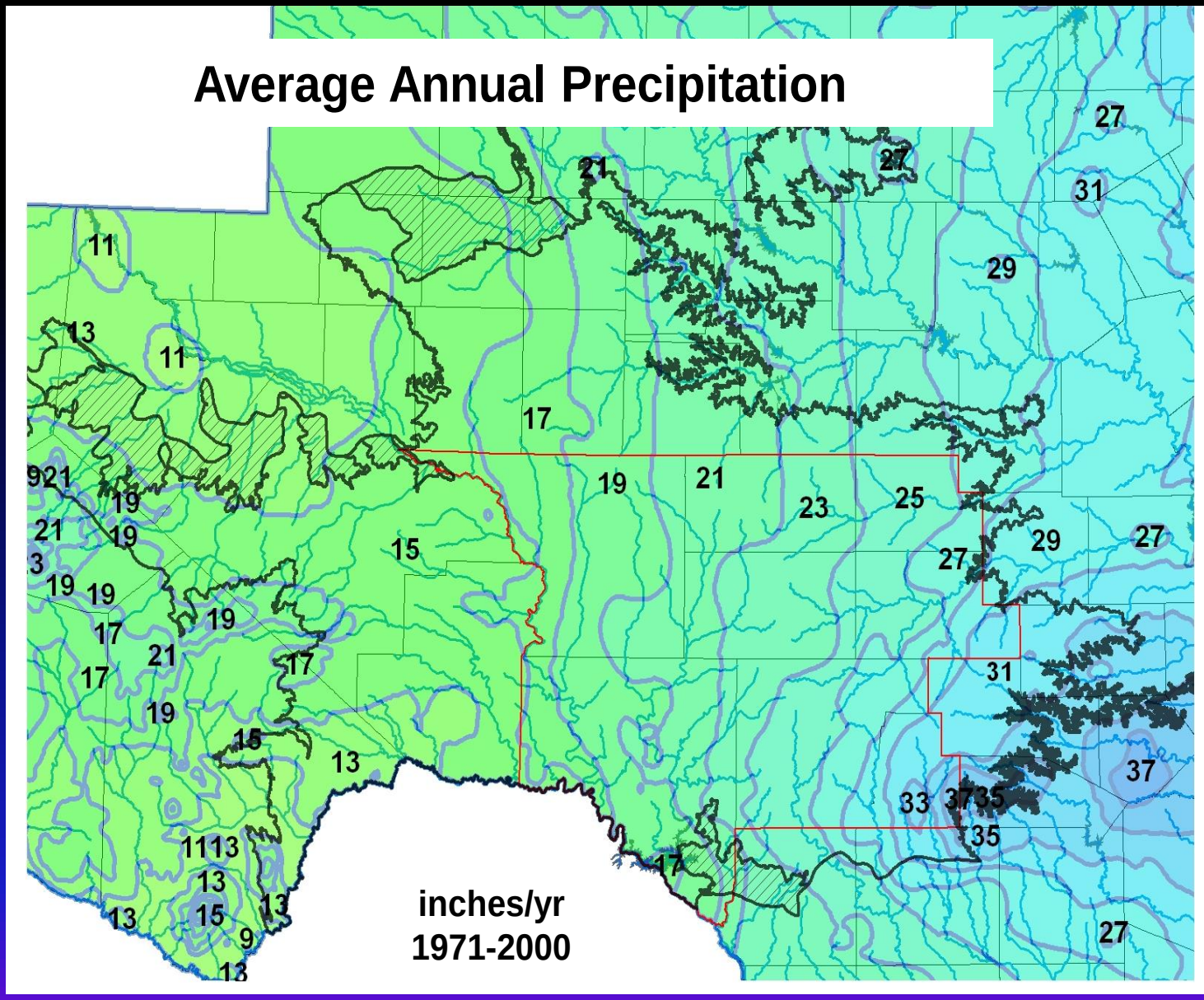


Table 4.0 Calculate Recharge Based on Percentage of Precipitation in Sutton County

Recharge Parameter	Sutton County
Calculated Recharge	75,556
Predicted recharge @ 90% precipitation	48,821
Predicted recharge @ 80% precipitation	22,086
Predicted recharge @ 70% precipitation	0
2004 GAM recharge	28,900
2007 Texas State Water Plan	20,775

Derivation of Modeled Available Groundwater (MAG) for Sutton County

- Predicted recharge at 90% - 48,821 ac-ft./year
- 20% pumpage rate - 9764 ac-ft./year (or 9800 ac-ft./year)

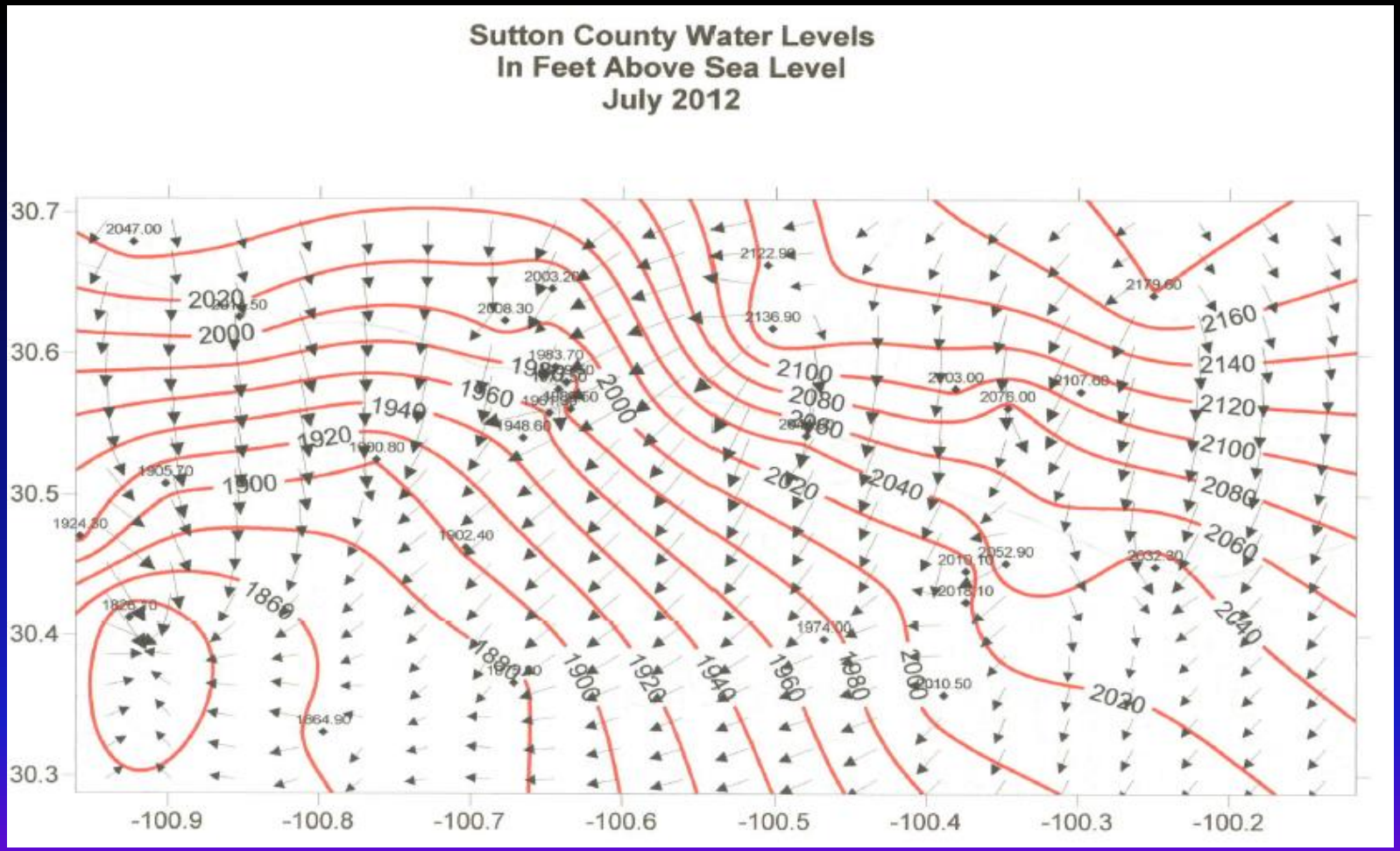
Table 5.0 User Group Water Consumption in Sutton County

User Group	Acre-Feet of Water
Municipal	895
Manufacturing	0
Domestic	265
Irrigation	745
Mining (Oil/Gas)	625
Livestock	653
Wildlife	245
Total	**3428**

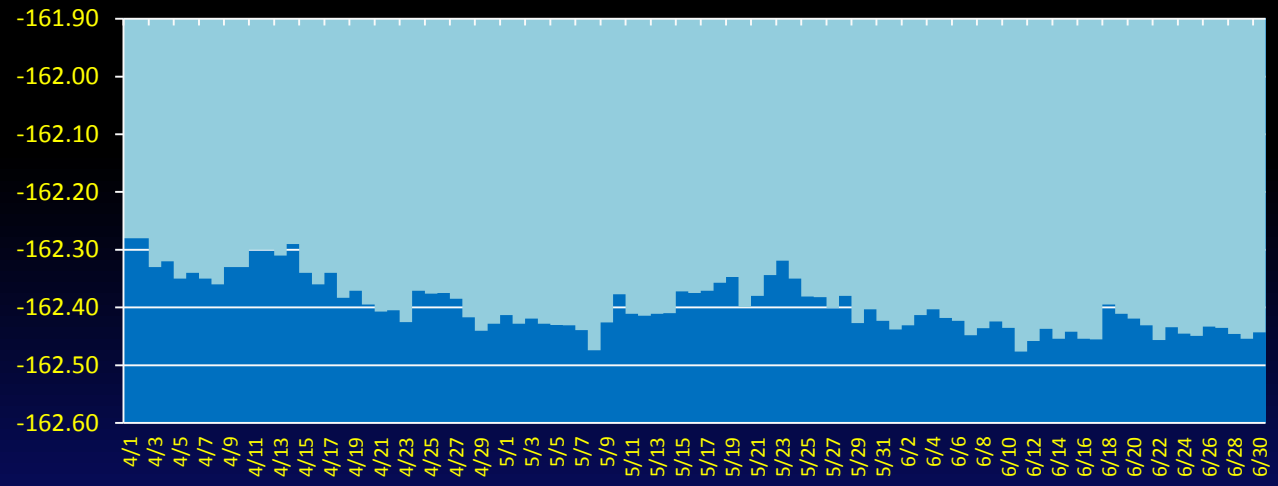
MAG for Sutton County

- Adjustments were made to compensate for under reporting amounts
- Water usage was increased by 10%
- Water usage by Oil/Gas is increased 30%
- Then 9800 ac-ft. - 3428 usage the MAG is 6372 ac-ft./year.

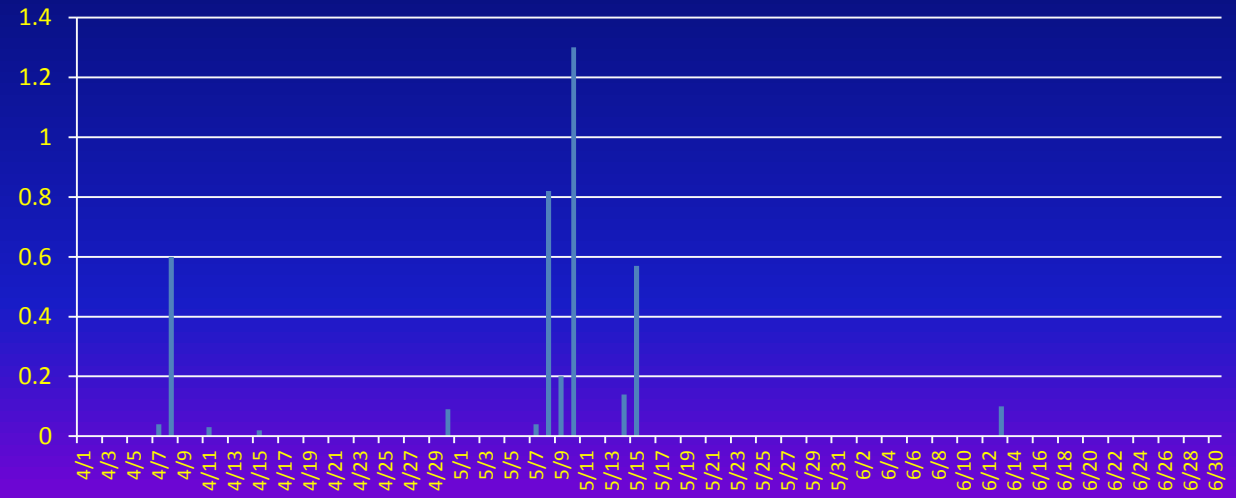
Water Flow Vector Map



SUTUWCD DCW 2nd Qtr. 2012 55-27-322 SN#: 305080
Level Surface Elevation (ft)



Sum: Event (Rainfall) SUTUWCD RMS #30 2nd Qtr. 2012
3.95" total



Summary

- Arid and semi-arid regions with high population growth 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
- Recharge is limited, uncertain, and varies from year to year
- Not advisable to target water resources located in areas with variable and unreliable recharge
- Climate change could exacerbate water shortage by increasing magnitude of variability and reducing precipitation/recharge