

<b>NWS FORM E-5</b> (11-88) (PRES. by NWS Instruction 10-924)	<b>U.S. DEPARTMENT OF COMMERCE</b> NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	HYDROLOGIC SERVICE AREA (HSA)	
		<b>Tulsa, Oklahoma (TSA)</b>	
<b>MONTHLY REPORT OF RIVER AND FLOOD CONDITIONS</b>		REPORT FOR:	
		MONTH <b>March</b>	YEAR <b>2017</b>
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		SIGNATURE <b>Steven F. Piltz</b> (Meteorologist-in-Charge)	
		DATE <b>April 7, 2017</b>	

When no flooding occurs, include miscellaneous river conditions, such as significant rises, record low stages, ice conditions, snow cover, droughts, and hydrologic products issued (NWS Instruction 10-924)

An "X" in the box indicates no flood stages were reached in this Hydrologic Service Area (HSA) during the month above.

Overall March 2017 was 4°-5° above normal, and despite some rain throughout the month, most of eastern OK and northwest AR had below normal precipitation for the month. Normal precipitation for March ranges from 3.1 inches in Pawnee County to 4.3 inches in Le Flore County. In the Ozark region of northwest Arkansas, the normal precipitation for the month is 4.4 inches. This report, past E-5 reports, and monthly hydrology and climatology summaries can be found at <http://www.weather.gov/tsa/hydro-monthly-summary>.

### Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 1a), rainfall totals for March 2017 ranged from around 0.50" to around 6". The highest totals were northwest of I-44 and along and east of the OK/AR state line. This corresponds from around 25% to around 150% of the normal March rainfall (Fig. 1b).

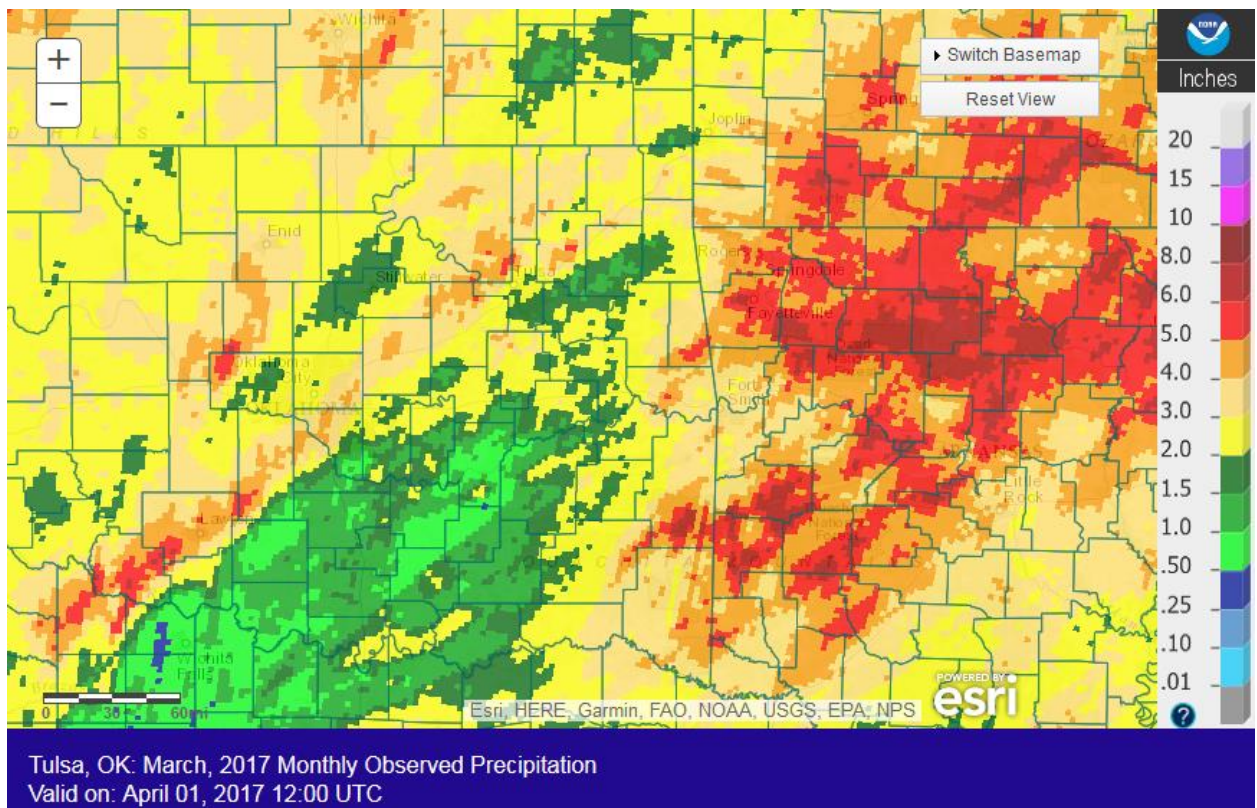


Fig. 1a. Estimated Observed Rainfall for March 2017

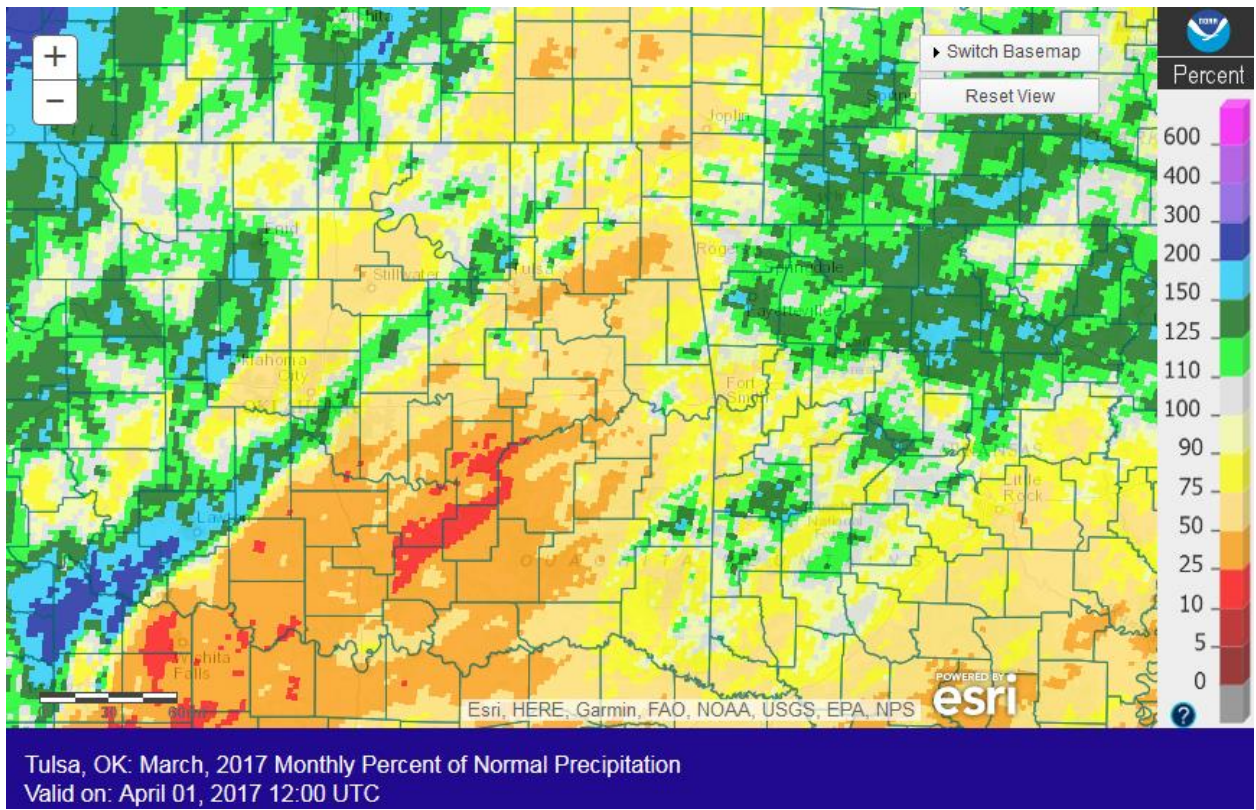


Fig. 1b. Estimated % of Normal Rainfall for March 2017

In Tulsa, OK, March 2017 ranked as the 12<sup>th</sup> warmest March (56.6°F; since records began in 1905) and the 45<sup>th</sup> driest March (1.77"; since records began in 1888). No snow fell this month, tying 37 other years for least snowy March since records began in 1900. Fort Smith, AR had the 14<sup>th</sup> warmest March (57.4°F; since records began in 1883) and the 52<sup>nd</sup> wettest March (3.75", tied 1904; since records began in 1883). No snow fell this month, tying 75 other years as least snowy March since records began in 1884. Fayetteville, AR had the 4<sup>th</sup> warmest (52.7°F, tied 1974), the 13<sup>th</sup> wettest (5.95"), and the 21<sup>st</sup> snowiest (0.2") March since records began in 1950.

Some of the larger precipitation reports (in inches) for March 2017 included:

Winslow 7NE, AR (coop)	7.53	Busch 0.4E, AR (coco)	7.04	Farmington 0.6WSW, AR (coco)	6.60
Garfield 3.9E, AR (coco)	6.57	Elkins 10.6SSE, AR (coco)	6.56	Holiday Island 1.3SSW, AR (coco)	6.40
St. Paul 1E, AR (coop)	6.29	Viney Grove 2.4NW, AR (coco)	6.24	Kingston 2S, AR (coop)	6.06

Some of the lowest precipitation reports (in inches) for March 2017 included:

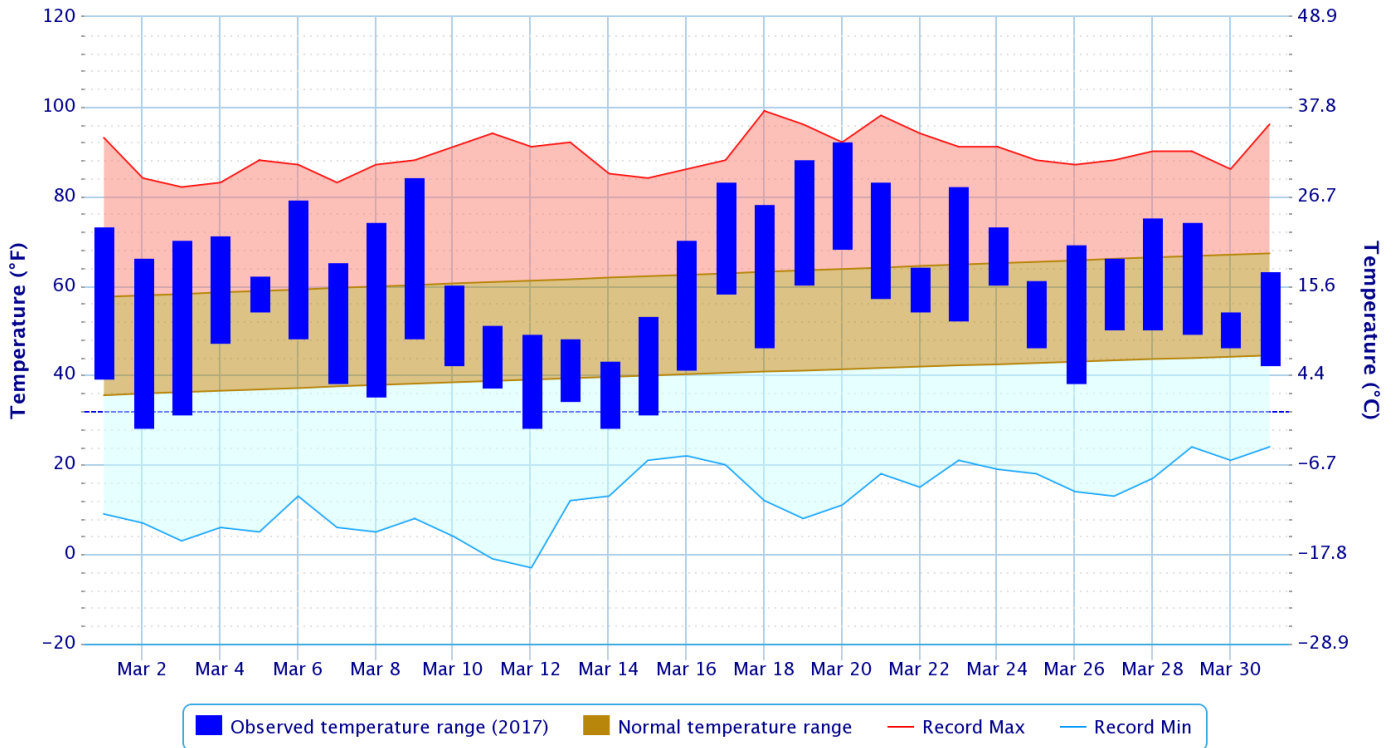
Broken Arrow 2.7SSW, OK (coco)	1.44	Antlers, OK (coop)	1.45	Eufaula, OK (meso)	1.50
Bixby, OK (meso)	1.56	Broken Arrow 4.6NNW, OK (coco)	1.66	McAlester, OK (ASOS)	1.72
Tulsa, OK (ASOS)	1.77	Tulsa 6.3S, OK (coco)	1.77	Inola, OK (meso)	1.78

According to statistics from the [Oklahoma Climatological Survey](#) (OCS) Mesonet:

Rank since 1921	March 2017	Last 60 Days (Jan 31 – Mar 31)	Year-to-Date (Jan 1 – Mar 31)	Last 120 Days (Dec 2 – Mar 31)	Water Year-to-Date (Oct 1 – Mar 31)	Last 365 Days (Apr 1, 2016–Mar 31, 2017)
Northeast OK	46 <sup>th</sup> driest	38 <sup>th</sup> driest	34 <sup>th</sup> wettest	48 <sup>th</sup> driest	41 <sup>st</sup> driest	29 <sup>th</sup> driest
East Central OK	31 <sup>st</sup> driest	41 <sup>st</sup> driest	39 <sup>th</sup> driest	27 <sup>th</sup> driest	12 <sup>th</sup> driest	17 <sup>th</sup> driest
Southeast OK	35 <sup>th</sup> driest	36 <sup>th</sup> driest	35 <sup>th</sup> driest	20 <sup>th</sup> driest	11 <sup>th</sup> driest	27 <sup>th</sup> driest
Statewide	48 <sup>th</sup> wettest	41 <sup>st</sup> wettest	22 <sup>nd</sup> wettest	36 <sup>th</sup> wettest	37 <sup>th</sup> driest	42 <sup>nd</sup> wettest

## Daily Temperature Data - Tulsa Area, OK (ThreadEx)

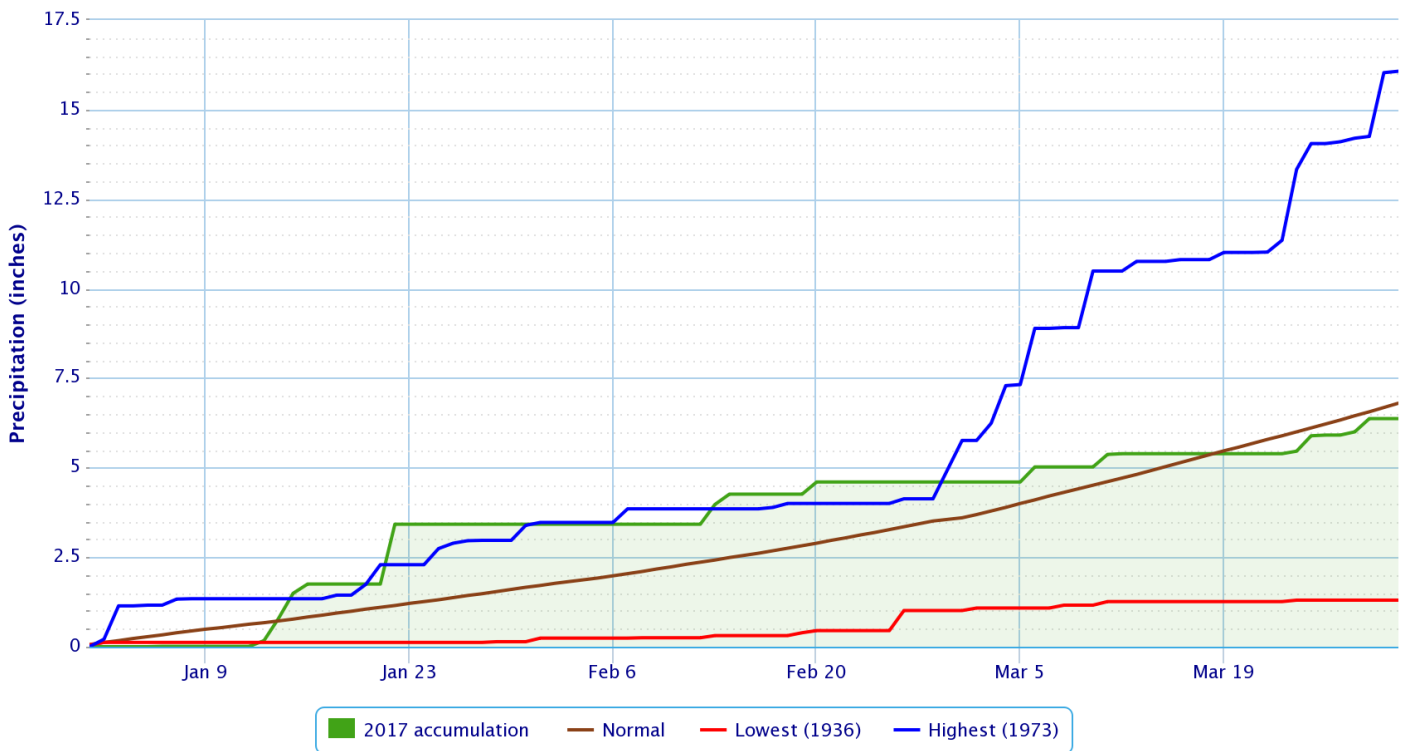
Period of Record - 1905-01-06 to 2017-04-02. Normals period: 1981-2010. Click and drag to zoom chart.



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## Accumulated Precipitation - Tulsa Area, OK (ThreadEx)

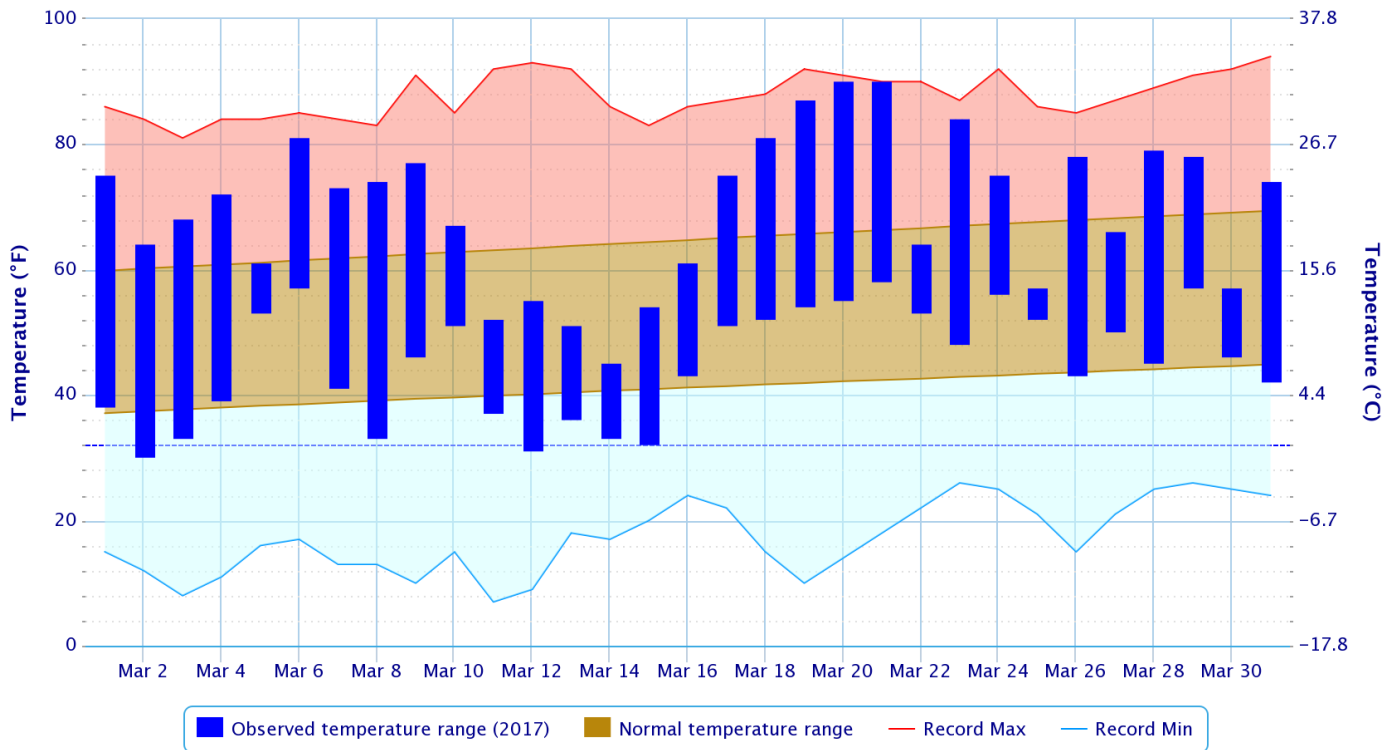
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

### Daily Temperature Data – Fort Smith Area, AR (ThreadEx)

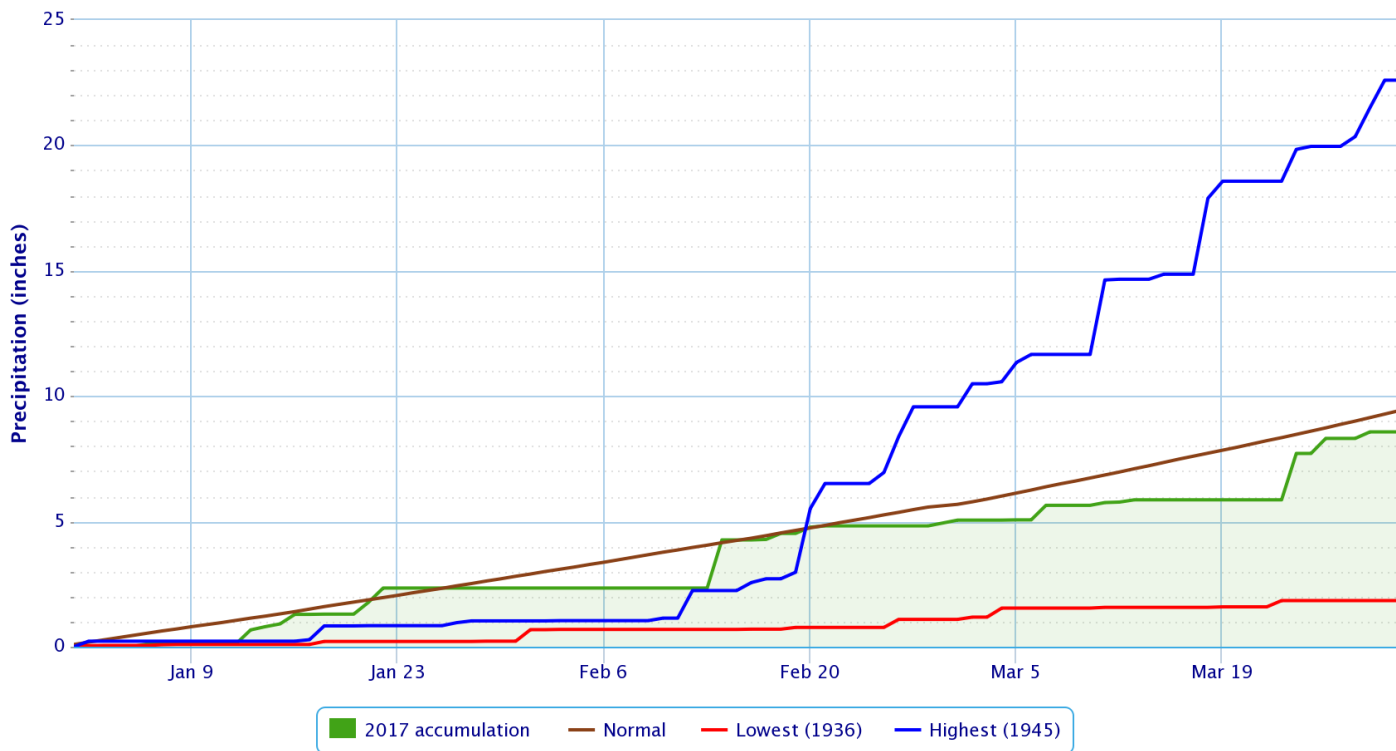
Period of Record – 1882–06–01 to 2017–04–02. Normals period: 1981–2010. Click and drag to zoom chart.



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### Accumulated Precipitation – Fort Smith Area, AR (ThreadEx)

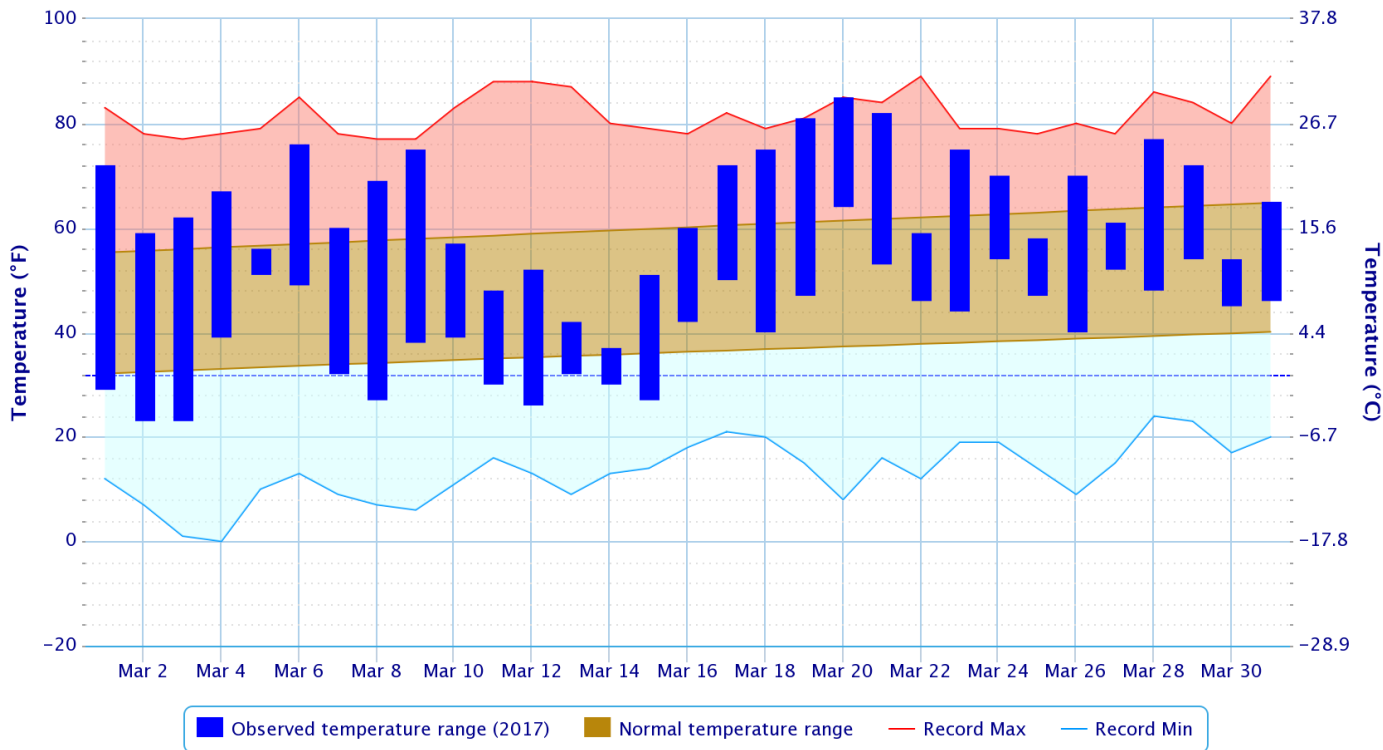
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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### Daily Temperature Data - FAYETTEVILLE DRAKE FLD, AR

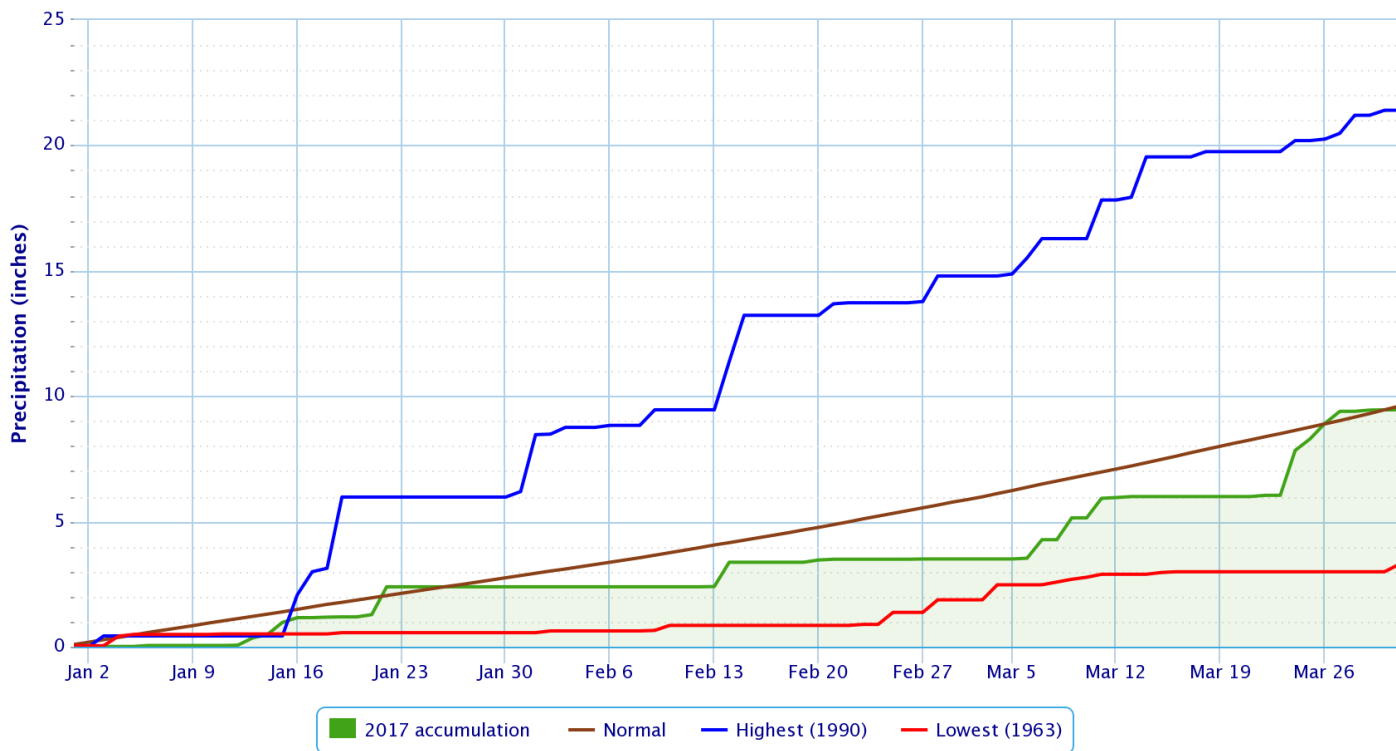
Period of Record - 1949-07-14 to 2017-04-02. Normals period: 1981-2010. Click and drag to zoom chart.



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### Accumulated Precipitation - FAYETTEVILLE DRAKE FLD, AR

Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values

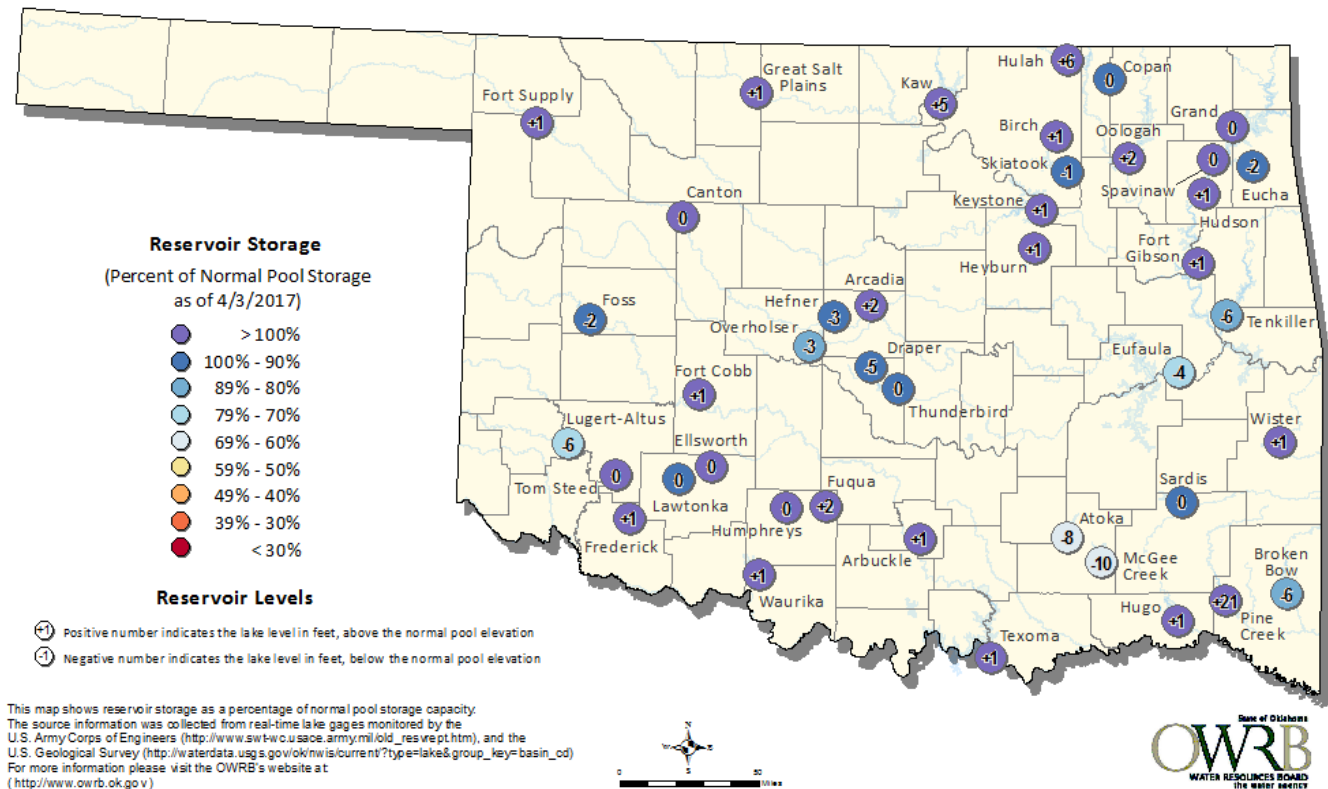


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## Reservoirs

# Oklahoma Surface Water Resources

## Reservoir Levels and Storage as of 4/3/2017



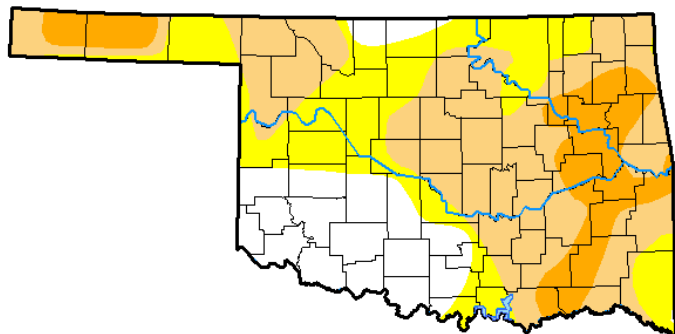
According to the USACE, the lakes in the HSA were  $\pm 5\%$  of the top of their conservation pool levels as of 3/31/2017, except for Hulah and Kaw Lakes, which were both operating within 9% of their flood control pools. Reservoirs operating more than 5% below the top of their conservation level include: Eufaula Lake 70%, Tenkiller Lake 78%, Beaver Lake 86%, Skiatook Lake 92%, and Copan Lake 94%.

## Drought

The rain at the end of the month helped to improve drought conditions across eastern OK and northwest AR. According to the [U.S. Drought Monitor](#) (USDM) from April 4, 2017 (Figs. 2, 3), D2 (Severe Drought) encompassed portions of Tulsa, Rogers, Wagoner, Mayes, Delaware, Cherokee, Muskogee, Okmulgee, McIntosh, Pittsburg, Haskell, Latimer, Le Flore, Choctaw, and Pushmataha Counties in eastern OK, and Sebastian, Crawford, and Franklin Counties in west central AR. D1 (Moderate Drought) conditions existed over portions of Osage, Pawnee, Washington, Tulsa, Rogers, Mayes, Craig, Ottawa, Delaware, Cherokee, Adair, Sequoyah, Creek, Okmulgee, Okfuskee, McIntosh, Pittsburg, Latimer, Le Flore, Choctaw, and Pushmataha Counties in eastern OK and Sebastian, Franklin, Crawford, Madison, Washington, Benton, and Carroll Counties in northwest AR. D0 (abnormally dry conditions but not in drought) were present across portions of Osage, Pawnee, Creek, Washington, Nowata, and Le Flore Counties in eastern OK, and Benton and Carroll Counties in northwest AR.

# U.S. Drought Monitor Oklahoma

**April 4, 2017**  
(Released Thursday, Apr. 6, 2017)  
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	19.43	80.57	54.67	14.50	0.00	0.00
<b>Last Week</b> <i>03-28-2017</i>	7.24	92.76	77.80	36.07	2.99	0.00
<b>3 Months Ago</b> <i>01-03-2017</i>	5.61	94.39	83.21	55.75	5.55	0.00
<b>Start of Calendar Year</b> <i>01-03-2017</i>	5.61	94.39	83.21	55.75	5.55	0.00
<b>Start of Water Year</b> <i>09-27-2016</i>	57.82	42.18	19.04	3.05	0.00	0.00
<b>One Year Ago</b> <i>04-05-2016</i>	26.84	73.16	31.31	0.00	0.00	0.00

Intensity:

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

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

Author:

Anthony Artusa  
NOAA/NWS/NCEP/CPC

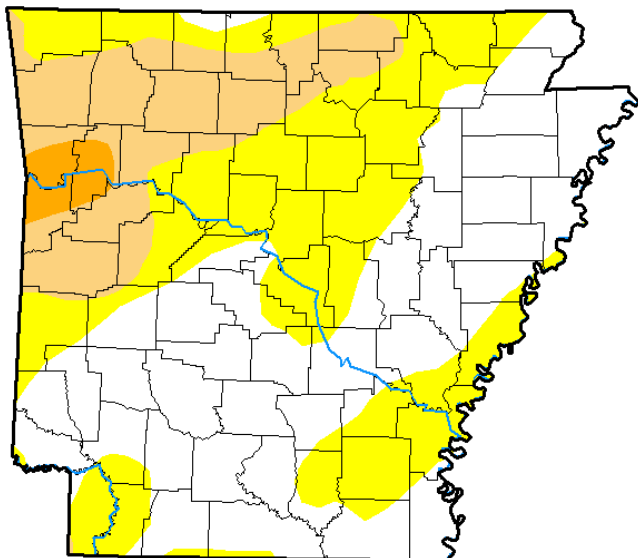


<http://droughtmonitor.unl.edu/>

Fig. 2. Drought Monitor for Oklahoma

# U.S. Drought Monitor Arkansas

**April 4, 2017**  
(Released Thursday, Apr. 6, 2017)  
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	45.98	54.02	18.90	2.07	0.00	0.00
<b>Last Week</b> <i>03-28-2017</i>	44.88	55.12	18.87	2.00	0.00	0.00
<b>3 Months Ago</b> <i>01-03-2017</i>	27.05	72.95	39.03	7.99	2.02	0.00
<b>Start of Calendar Year</b> <i>01-03-2017</i>	27.05	72.95	39.03	7.99	2.02	0.00
<b>Start of Water Year</b> <i>09-27-2016</i>	71.02	28.98	0.00	0.00	0.00	0.00
<b>One Year Ago</b> <i>04-05-2016</i>	93.64	6.36	0.00	0.00	0.00	0.00

Intensity:

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

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

Author:

Anthony Artusa  
NOAA/NWS/NCEP/CPC



<http://droughtmonitor.unl.edu/>

Fig. 3. Drought Monitor for Arkansas

## Outlooks

The [Climate Prediction Center](#) (CPC) outlook for April 2017 (issued March 31, 2017) indicates an enhanced chance for above normal temperatures across all of eastern OK and northwest AR. This outlook also indicates a slightly enhanced chance for above median rainfall along the Red River in Choctaw County in southeast OK, with an equal chance of above, near, and below median rainfall elsewhere. This outlook takes into account weather conditions forecast over the next 1-2 weeks and to a lesser extent, subseasonal climate signals in the weeks 3-4 time frame. Madden-Julian Oscillation (MJO) activity is expected to be inactive through much of April and therefore, wasn't considered in the outlook.

For the 3-month period April-May-June 2017, CPC is forecasting an enhanced chance for above normal temperatures and an equal chance for above, near, and below median rainfall across all of eastern OK and northwest AR (outlook issued March 16, 2017). This outlook is based on both statistical and dynamical forecast tools and decadal timescale climate trends. According to CPC, Pacific sea surface temperatures along the equator continue to indicate ENSO-neutral conditions, which are favored to persist through the spring. There is significant uncertainty in the ENSO phase beyond that time, though there are increasing odds of El Niño conditions developing as autumn approaches.

**Summary of Precipitation Events** Daily quality controlled rainfall maps can be found at: [http://water.weather.gov/precip/index.php?location\\_type=wfo&location\\_name=tsa](http://water.weather.gov/precip/index.php?location_type=wfo&location_name=tsa)

### March 1-15

Shortly after midnight on the 5<sup>th</sup>, isolated areas of light rain moved north out of TX and into southeast OK as moisture return increased over the region. This activity persisted through the mid-morning hours. Rainfall from these showers ranged from around 0.50" to a few hundredths of an inch across southeast OK and west central AR.

Thunderstorms developed during the evening of the 6<sup>th</sup> along a cold front from Kansas into Oklahoma. This line of storms swept east across eastern OK and northwest AR during the evening and into the early morning hours of the 7<sup>th</sup>. Additional isolated thunderstorms developed during the evening in the unstable airmass ahead of the cold front and squall line, mainly affecting far eastern OK and northwest AR. Damage occurred across eastern Oklahoma and west central Arkansas as the squall line produced straight-line winds of 50 to near 70 mph and hail. Tree damage occurred and power lines were downed throughout the storm path. Two EF-1 tornadoes occurred with a discrete severe thunderstorm that developed ahead of the squall line. Additional information from this event can be found at <http://arcg.is/2m0UfGi> Near all of eastern OK and northwest AR received rainfall during this event, with totals of around 0.10" to around 2.5" (Figs. 4, 5).

During the mid-evening hours on the 9<sup>th</sup>, thunderstorms developed along an outflow boundary from storms in KS/MO and along a weak front across northeast OK and far northwest AR. The broken line of storms swept southeast through eastern OK and western AR, before moving south of the area a couple of hours after midnight. Rainfall totals ranged from around 0.10" to near 1.5" (Fig. 6). These storms produced golf ball (1.75") hail in several locations, with one report of 2.5" hail in Grove, OK.

Widely scattered showers and isolated thunderstorms developed across northeast OK and northwest AR north of I-40 soon after midnight on the 11<sup>th</sup>. This activity became more widespread through the morning and continued to affect locations north of I-40 through the afternoon, all while temperatures were falling. Sleet mixed in with the rain at times, with temperatures cold enough across northwest AR for snow. A trace to 3" of snow accumulation occurred over northwest AR (Fig. 7). By mid-evening, the area of precipitation began to shift south, weakened, and came to an end by midnight. North of I-40, rainfall totals were 0.10" to around 1", while only a few hundredths of an inch fell south of I-40.

As a fast moving upper-level system moved through the southern plains, an area of showers developed and moved southeast across eastern OK and northwest AR from late evening on the 12<sup>th</sup> through the early morning hours of the 13<sup>th</sup>. Most locations received around 0.10" or less, with a few spots receiving around 0.25".



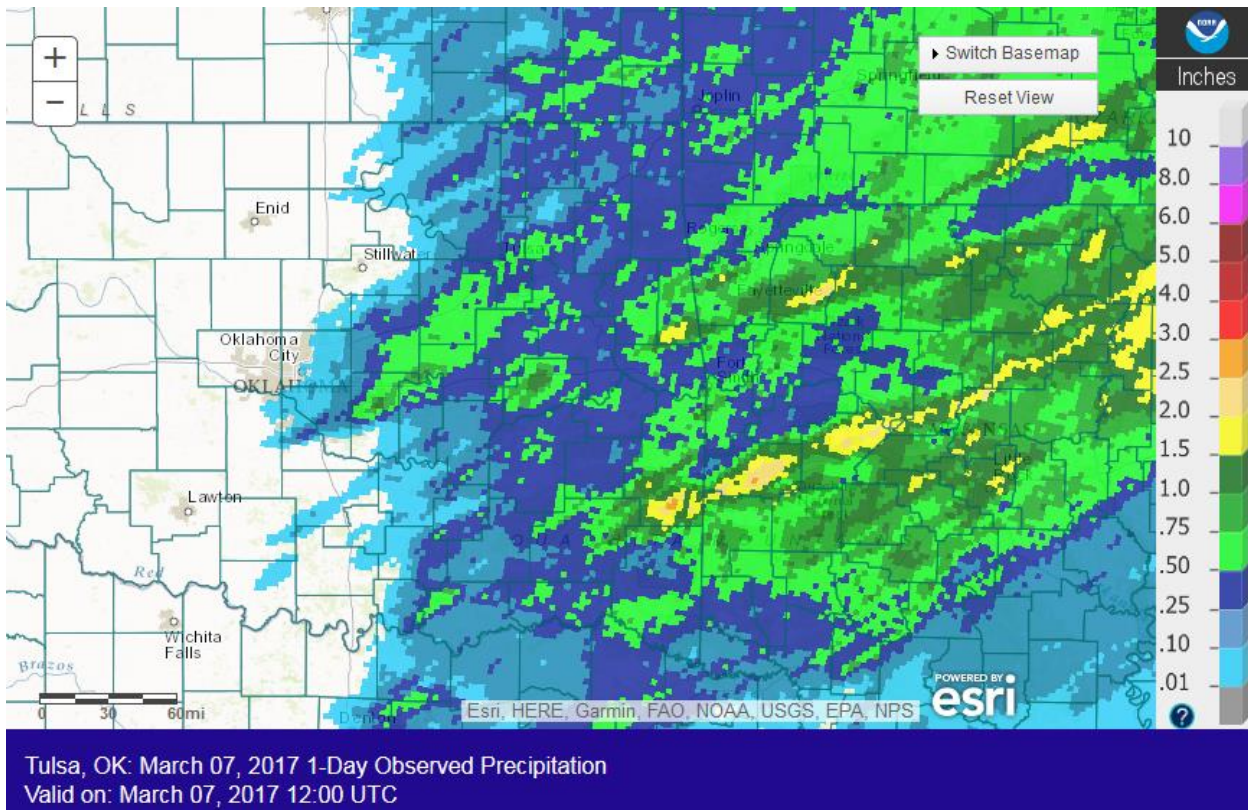


Fig. 4. 24-hour Estimated Observed Rainfall ending at 6am CST 3/15/2017.

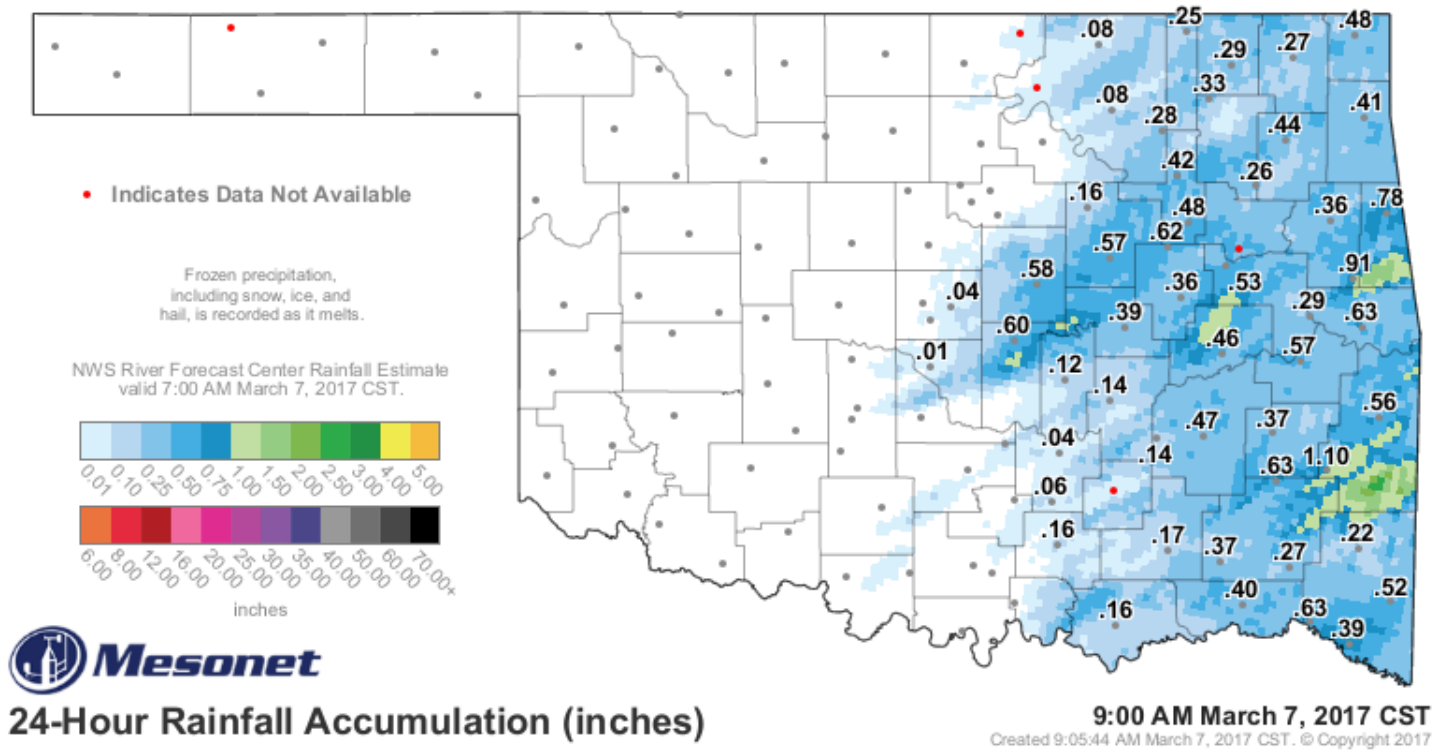


Fig. 5. 24-hour Estimated Observed Rainfall (image) and OK Mesonet measurements ending at 9:00 am CST 03/07/2017.



Fig. 6. 24-hour Estimated Observed Rainfall ending at 6am CST 3/10/2017.



Fig. 7. Snowfall total estimate for March 11, 2017.

## March 16-31

Widely scattered showers and thunderstorms developed along the AR/MO state line near a weak front during the mid-evening hours of the 17<sup>th</sup> and moved south through the evening. This activity exited the area a few hours after midnight. Rainfall totals of around 0.10" to around 0.33" were mainly confined to northwest AR and Cherokee and Adair Counties in northeast OK.

Showers and thunderstorms developed around sunrise on the morning of the 21<sup>st</sup> across northeast OK ahead of a cold front. This activity quickly moved east southeast across northwest AR before leaving the area by noon. Additional storms redeveloped near the OK/MO/AR state lines during the late evening and continued to affect far northeast OK and northwest AR through the overnight hours. Rainfall totals from both rounds of rain ranged from a few hundredths to near 1", with the highest totals over Benton, Carroll, and northern Madison Counties. Nickel to quarter sized hail also was reported.

Scattered showers and thunderstorms first developed along a cold front over eastern OK on the morning of the 24<sup>th</sup>, and increased in coverage through the afternoon hours. Widespread thunderstorms continued through the evening across far eastern OK and western AR, bringing periods of heavy rain and strong winds. As the storms moved east through AR, additional storms moved in from central OK around the eastward progressing low pressure center during the evening. This activity continued eastward through the overnight hours and morning hours of the 25<sup>th</sup>, before pushing east of the area by noon. Small hail from one storm covered the ground near Owasso during the night. All of eastern OK and northwest AR received precipitation from these storms, with rainfall totals from less than 0.10" to near 4" (Fig. 8).

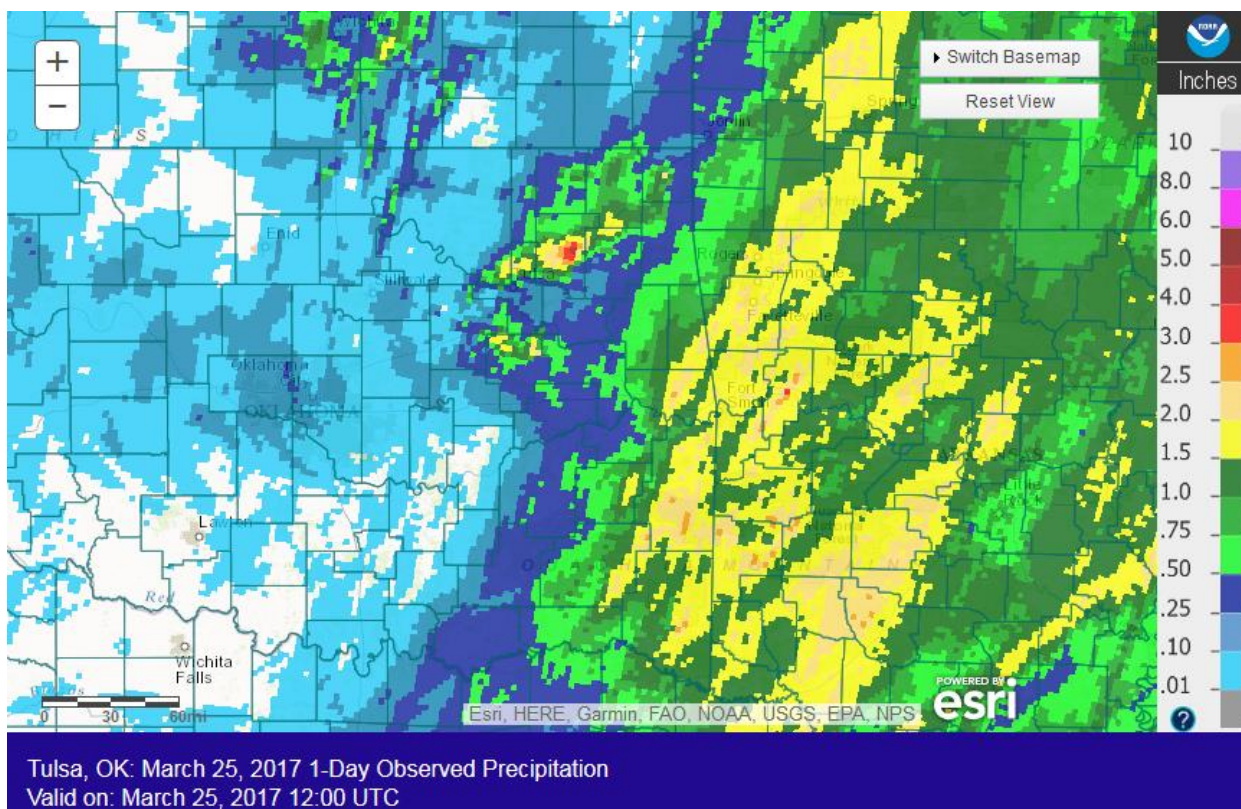
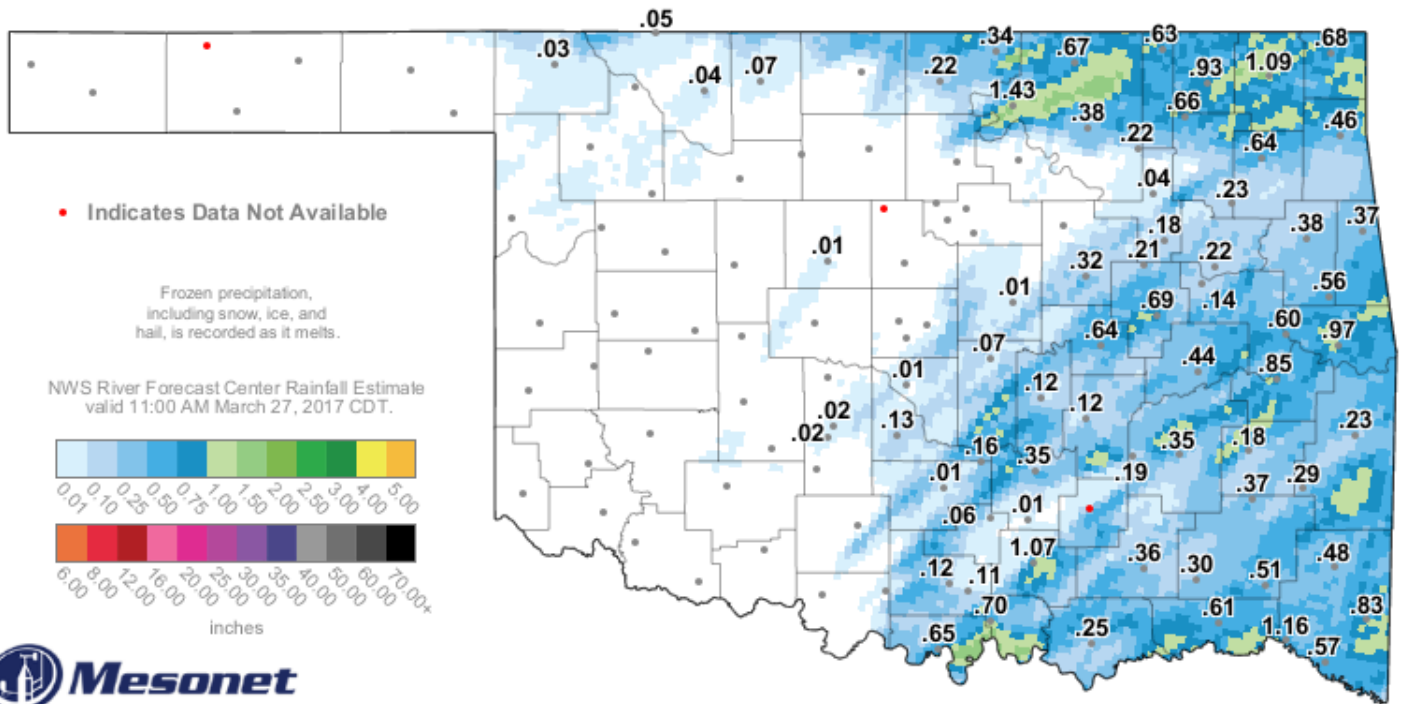


Fig. 8. 24-hour Estimated Observed Rainfall ending at 7am CDT 3/25/2017.

A low pressure system with a dry line and cold front resulted in several rounds of showers and thunderstorms across eastern OK and northwest AR from the afternoon of the 26<sup>th</sup> through the mid-morning hours of the 27<sup>th</sup>. A few of these storms produced hail, including one report of 1.75" hail near McAlester, and damaging winds. Rainfall totals for most locations were 0.25" to 1", with smaller areas receiving 1"-2" of rain (Figs. 9, 10).



## 24-Hour Rainfall Accumulation (inches)

12:00 PM March 27, 2017 CDT

Created 12:05:42 PM March 27, 2017 CDT. © Copyright 2017

Fig. 9. 24-hour Estimated Observed Rainfall (image) and OK Mesonet measurements ending at 12:00 pm CDT 03/27/2017.

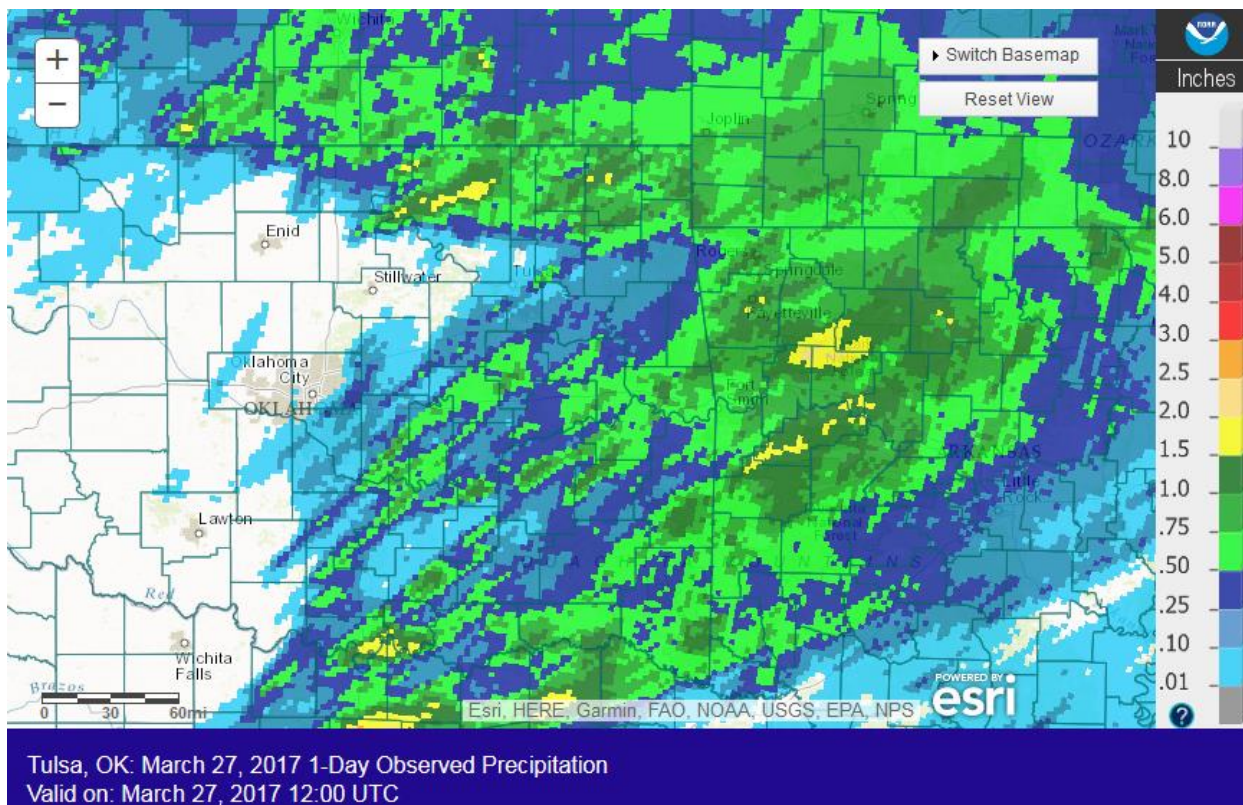


Fig. 10. 24-hour Estimated Observed Rainfall ending at 7am CDT 3/27/2017.

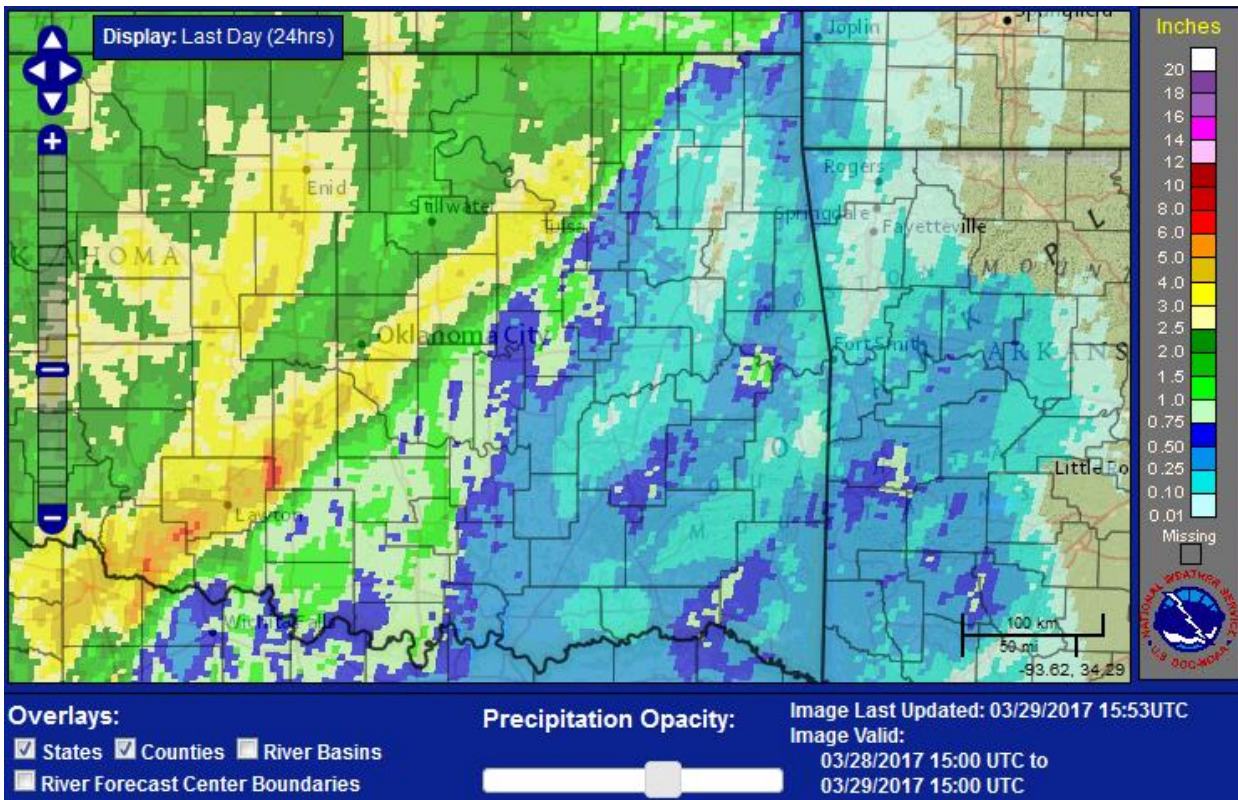


Fig. 11. 24-hour Estimated Observed Rainfall ending at 10am CDT 3/29/2017.

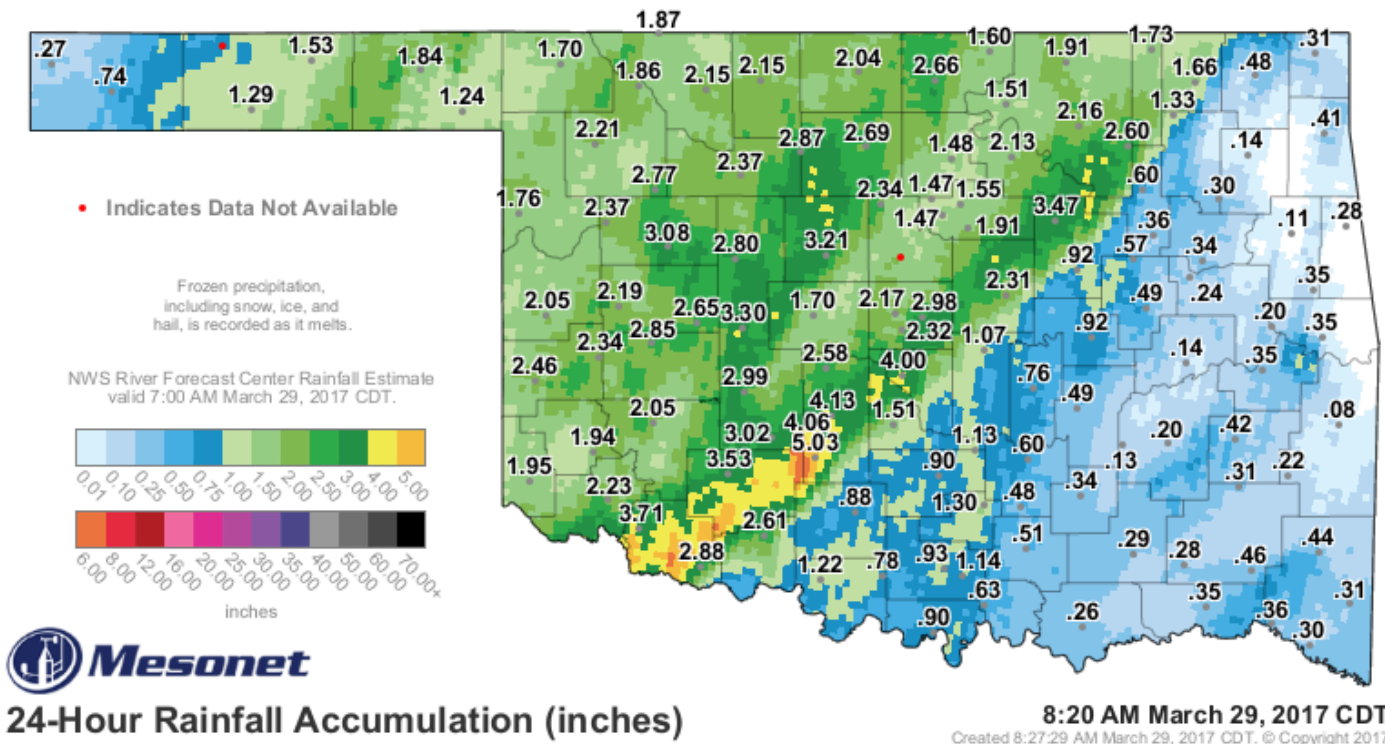


Fig. 12. 24-hour Estimated Observed Rainfall (image) and OK Mesonet measurements ending at 8:20am CDT 03/29/2017.

A large area of showers and thunderstorms developed over western and central OK and began to move into eastern OK during the evening of the 28<sup>th</sup>. The heaviest of the storms remained northwest of I-44 in northeast OK through the overnight hours, with weaker convection moving into all of eastern OK and northwest AR during the early- through mid-morning hours of the 29<sup>th</sup>. Some isolated to widely scattered showers and thunderstorms redeveloped during the afternoon and evening, but were generally short-lived. Along and northwest of I-44, most locations received 0.75" to 4" of rain, while elsewhere, totals were around 0.10" to around 1" (Figs. 11, 12). The 7-day period from the 24<sup>th</sup>-30<sup>th</sup> brought 2"-4" of rain to areas northwest of I-44 and southeast of a Hugo, OK to Bentonville, AR line (Fig. 13).

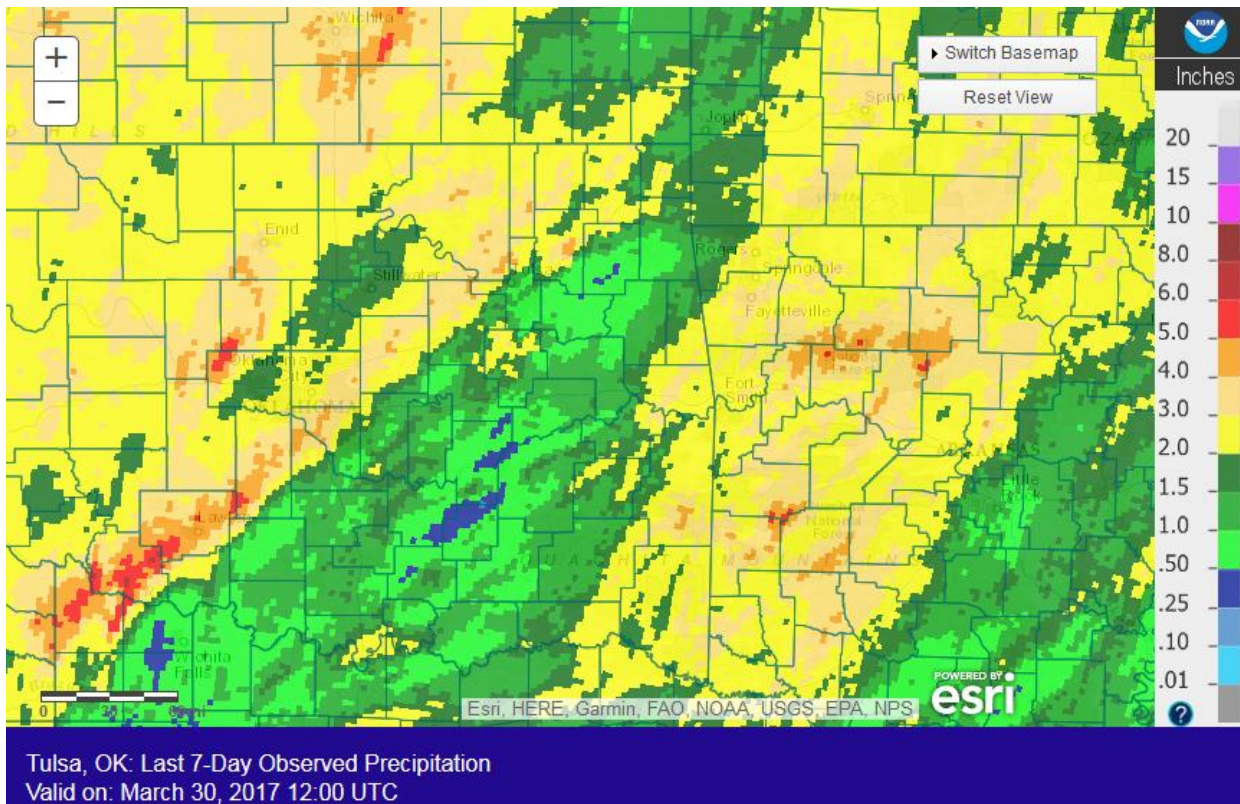


Fig. 13. 7-Day Estimated Observed Rainfall ending at 7am CDT 3/30/2017.

Written by:

Nicole McGavock  
Service Hydrologist  
WFO Tulsa

**Products issued in March 2017:**

- \*CWYO2 became a daily river forecast point September 7, 2016
- \*MLBA4 and OZGA4 transferred to NWS Tulsa HSA February 5, 2014
- \*Mixed case River Flood products began July 31, 2013

- 1 Flash Flood Warnings (FFW)
- 2 Flash Flood Statements (FFS)
- 0 Flash/Areal Flood Watches (FFA) (0 Watch FFA CON/EXT/EXA/EXB/CAN)
- 3 Urban and Small Stream Advisories (FLS)
- 0 Areal Flood Warnings (FLW)
- 0 Areal Flood Statements (FLS)
- 0 River Flood Warnings (FLW)
- 0 River Flood Statements (FLS)
- 0 River Flood Advisories (FLS) (0 Advisory FLS CON/EXT/CAN)
- 0 River Flood Watches (FFA) (0 Watch FFA CON/EXT/CAN)
- 0 River Statements (RVS)
- 1 Hydrologic Outlooks (ESF)
- 1 Drought Information Statements (DGT)

**Preliminary Hydrographs:**

None