

NWS FORM E-5 (11-88) (PRES. by NWS Instruction 10-924)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	HYDROLOGIC SERVICE AREA (HSA)	
		Tulsa, Oklahoma (TSA)	
MONTHLY REPORT OF RIVER AND FLOOD CONDITIONS		REPORT FOR:	
		MONTH September	YEAR 2016
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		SIGNATURE Steven F. Piltz (Meteorologist-in-Charge)	
		DATE October 5, 2016	

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.

Most of eastern OK and northwest AR had well above normal temperatures and well below normal rainfall in September 2016. But, heavy rain in KS resulted in downstream flooding in northeast OK. Normal rainfall for September ranges from 4.2 inches in Okmulgee County to 5.4 inches in Delaware County. In the Ozark region of northwest Arkansas, rainfall averages 4.5 inches for the month. 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 September 2016 ranged from around 0.25" to around 6". The greatest deficits were over Cherokee and Adair Counties, while the highest totals were in Craig, Ottawa, Delaware, Benton, Carroll, Madison, and Le Flore Counties. This corresponds to 10% to near 90% of the normal September rain for most of eastern OK and northwest AR (Fig. 1b), with just a few locations 90% to 150% of normal.

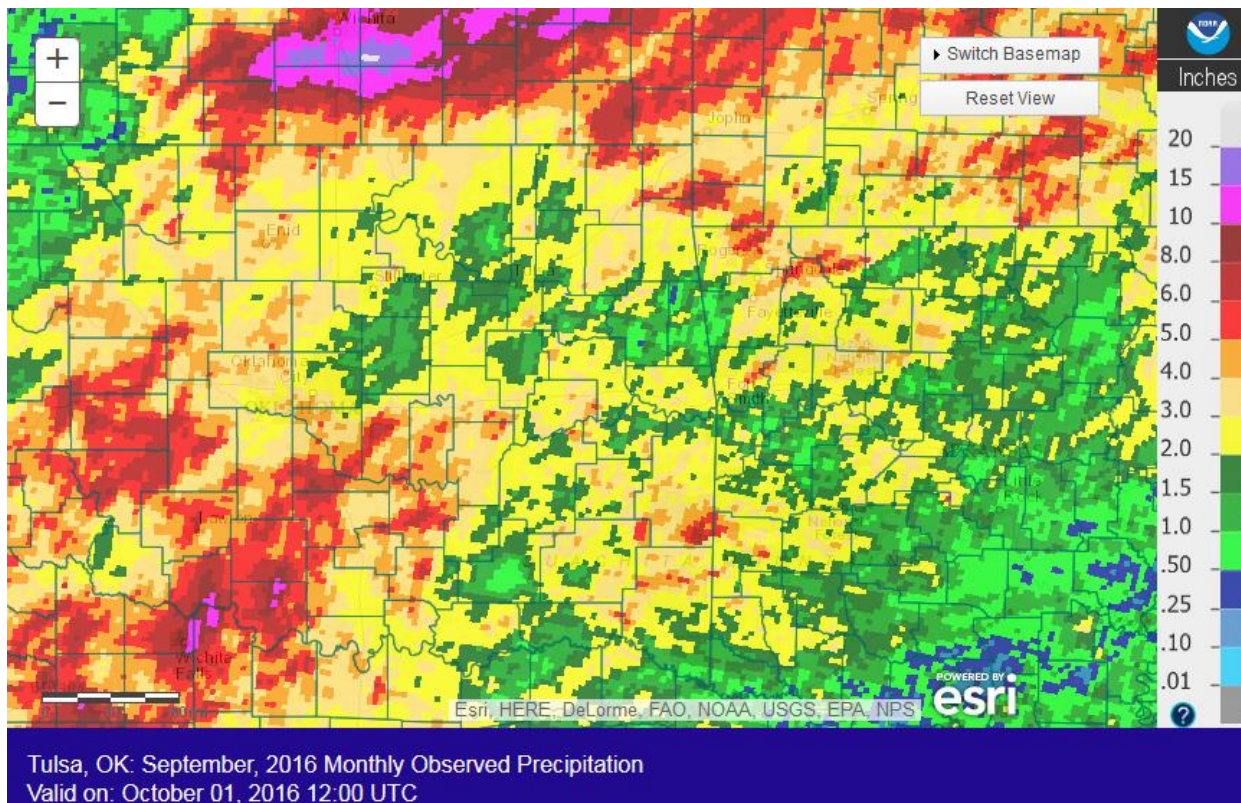


Fig. 1a. Estimated Observed Rainfall for September 2016

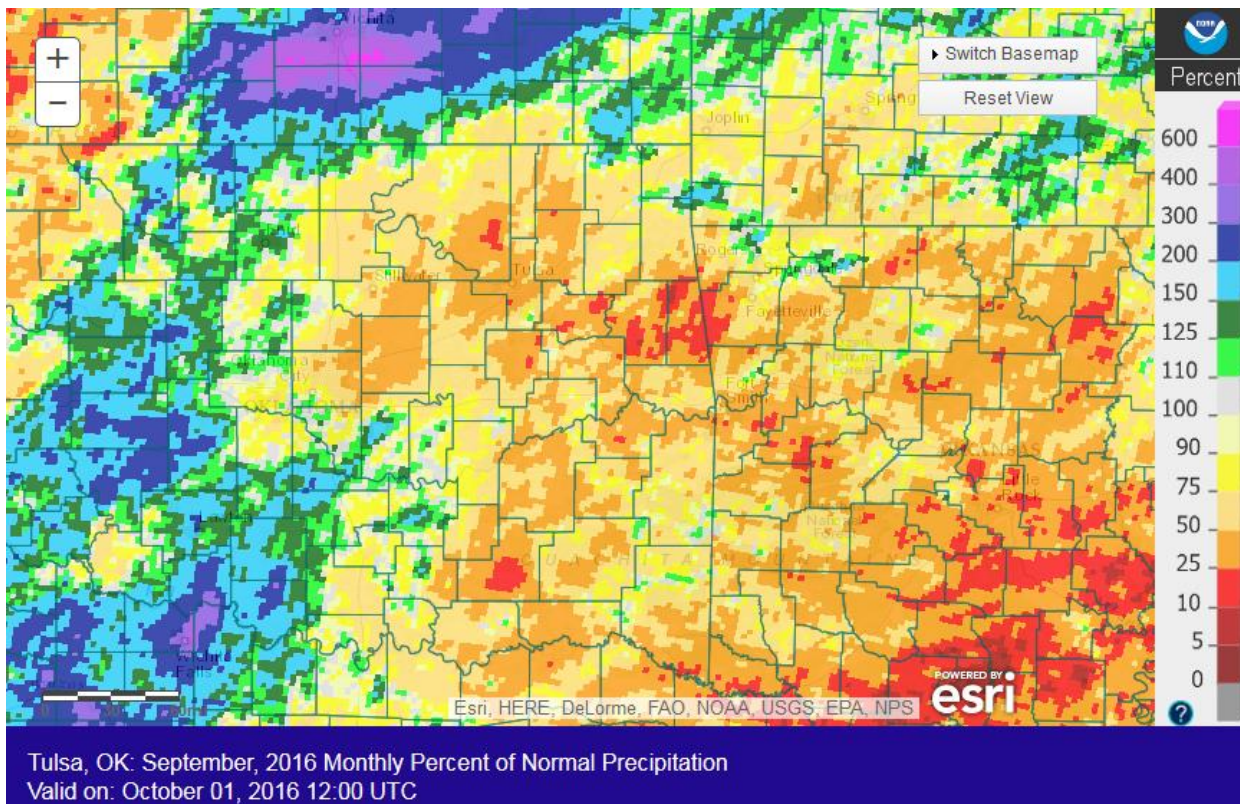


Fig. 1b. Estimated % of Normal Rainfall for September 2016

In Tulsa, OK, September 2016 ranked as the 19th warmest September (77.0°F; since records began in 1905) and the 48th driest September (2.31"; since records began in 1888). Fort Smith, AR had the 18th warmest September (77.4°F, tied 1938, 1930; since records began in 1882) and the 36th driest September (1.79", tied 2012; since records began in 1882). Fayetteville, AR had the 20th warmest (70.9°F, tied 1988, 1973) and the 20th driest (2.64") September since records began in 1949.

Some of the larger precipitation reports (in inches) for September 2016 included:

Little Flock 2.0NNE, AR (coco)	7.00	Drumright 0.6SW, OK (coco)	5.77	Jay 3.3NNE, OK (coco)	5.50
Fairview, OK (meso)	5.36	Hindsville 10NNE, AR (coop)	5.21	Bunch 0.8N, OK (coco)	5.05
Spavinaw, OK (coop)	4.98	Decatur 2.6ESE, AR (coco)	4.93	Upper Spavinaw Port, OK (coop)	4.59

Some of the lowest precipitation reports (in inches) for September 2016 included:

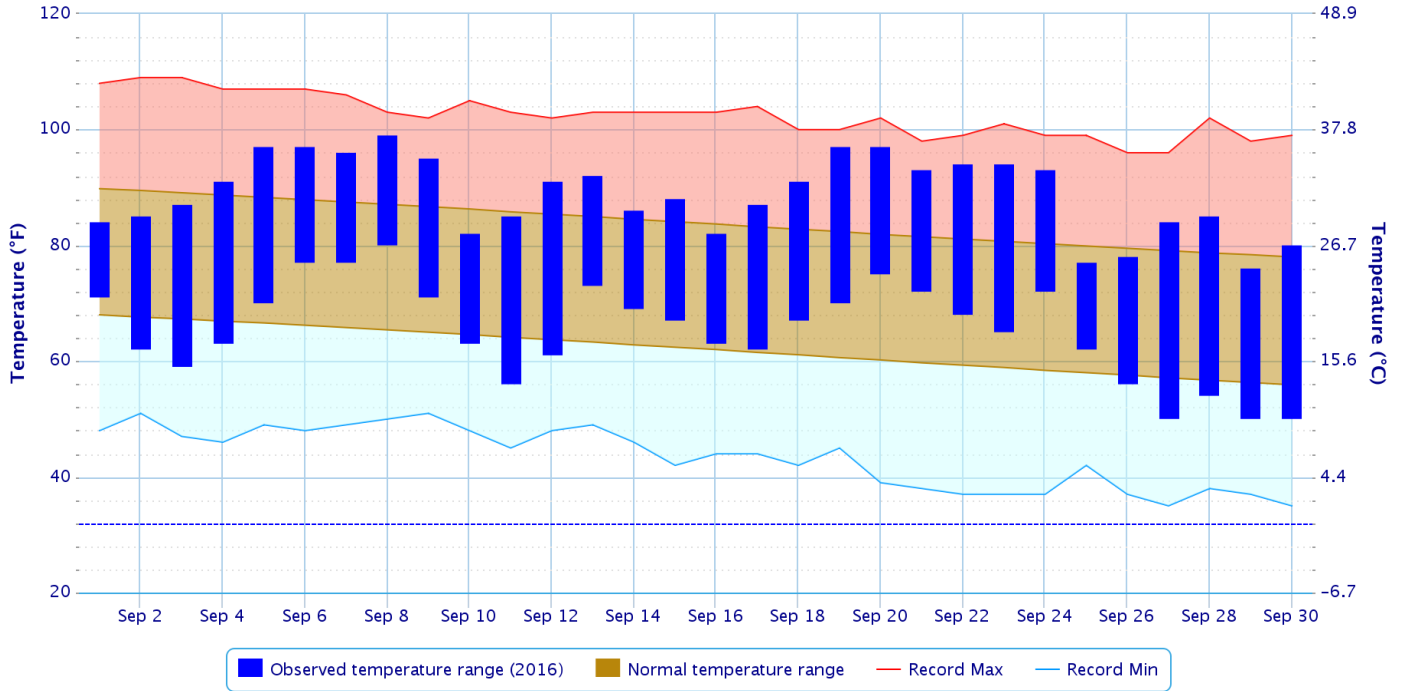
Charleston 1.7E, AR (coco)	0.78	Ozark 4.6S, AR (coco)	1.23	Talala, OK (meso)	1.31
Morris 2.4SW, OK (coco)	1.39	Jenks Riverside Arpt, OK (ASOS)	1.39	Ozark, AR (coop)	1.42
Sperry 6.7WNW, OK (coco)	1.45	Westville, OK (meso)	1.51	Wynona, OK (meso)	1.52

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

Rank since 1921	Sept. 1-30	Last 60 Days (Aug 2 – Sep 30)	Last 90 Days (Jul 3 – Sep 30)	Last 120 Days (Jun 3 – Sep 30)	Last 180 Days (Apr 4 – Sep 30)	Year-to-Date (Jan 1 – Sep 30)	Water Year 2016 (Oct 1, 2015–Sep 30, 2016)
Northeast OK	32 nd driest	20 th driest	43 rd driest	19 th driest	34 th driest	24 th driest	26 th wettest
East Central OK	28 th driest	20 th driest	44 th driest	21 st driest	37 th driest	26 th driest	12 th wettest
Southeast OK	35 th driest	28 th wettest	33 rd wettest	30 th driest	32 nd wettest	34 th wettest	4th wettest
Statewide	48 th wettest	48 th wettest	41 st wettest	40 th driest	29 th wettest	45 th wettest	13 th wettest

Daily Temperature Data – Tulsa Area, OK (ThreadEx)

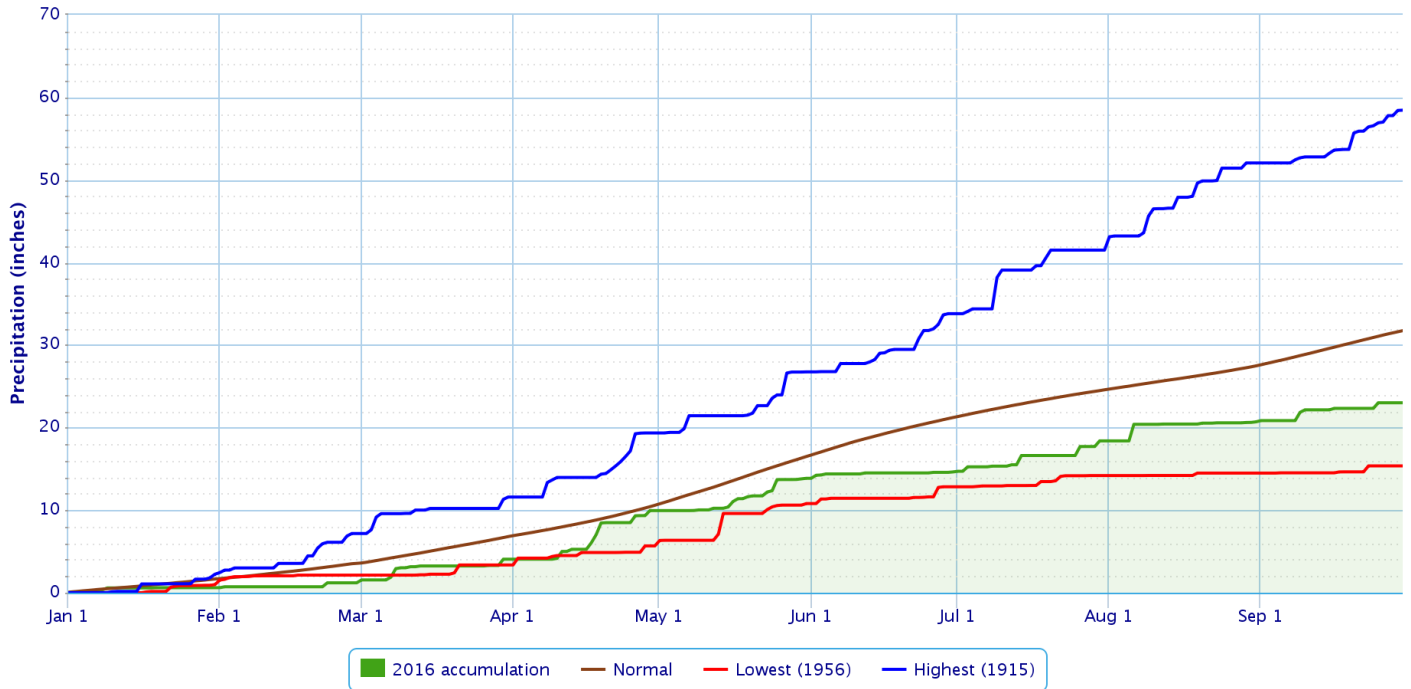
Period of Record – 1905-01-06 to 2016-10-03. Normals period: 1981-2010. Click and drag to zoom chart.



Powered by ACIS

Accumulated Precipitation – Tulsa Area, OK (ThreadEx)

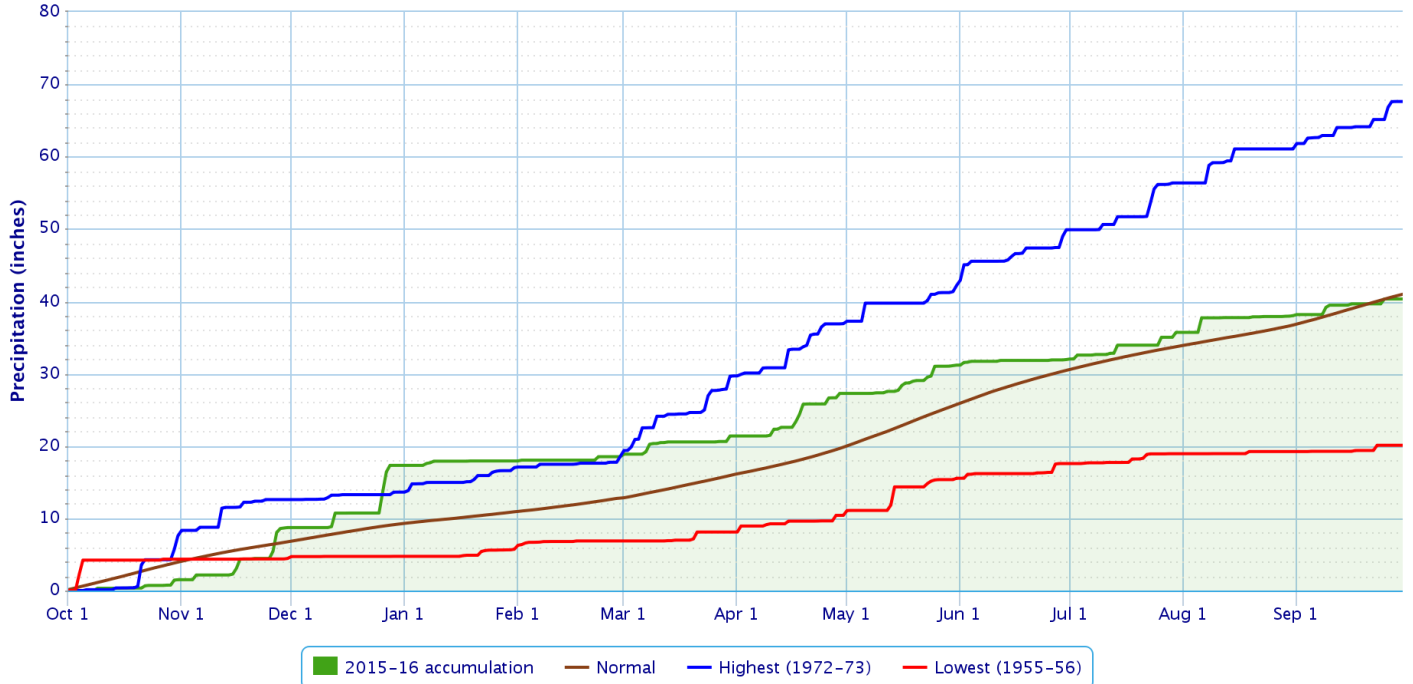
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

Accumulated Precipitation – Tulsa Area, OK (ThreadEx)

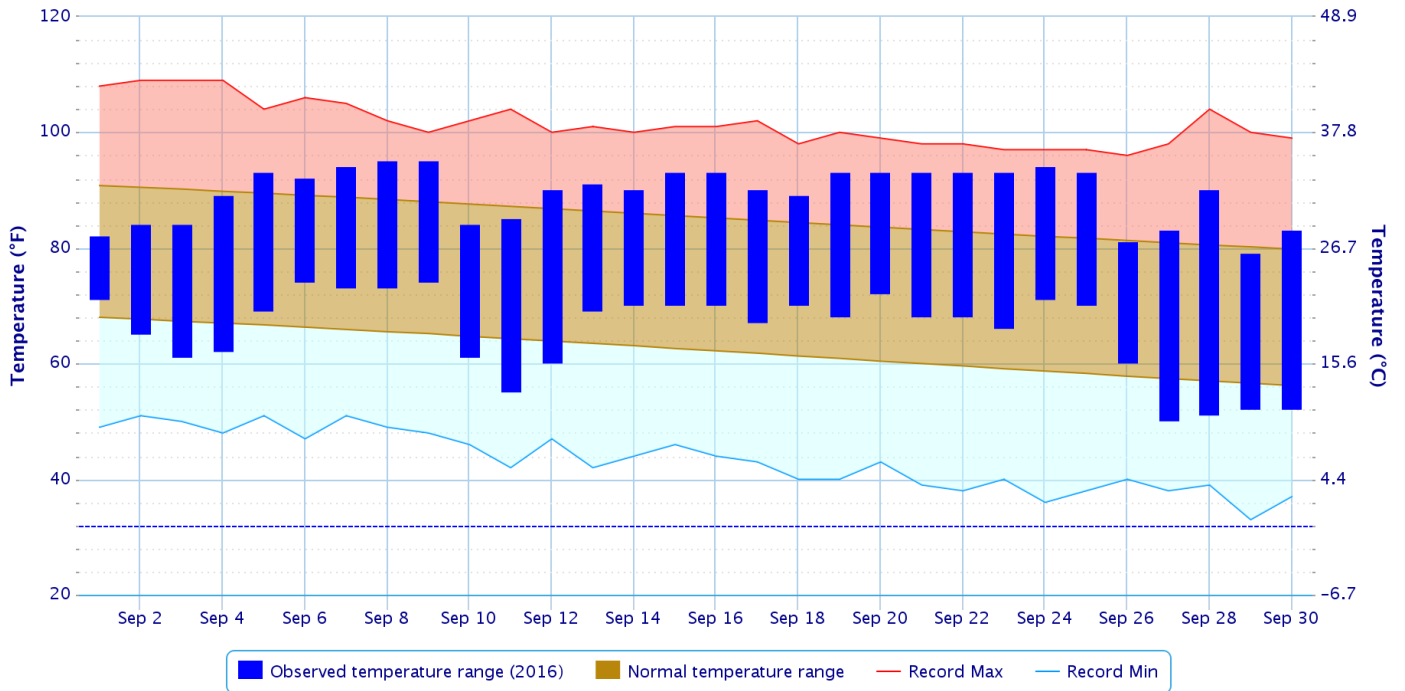
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

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

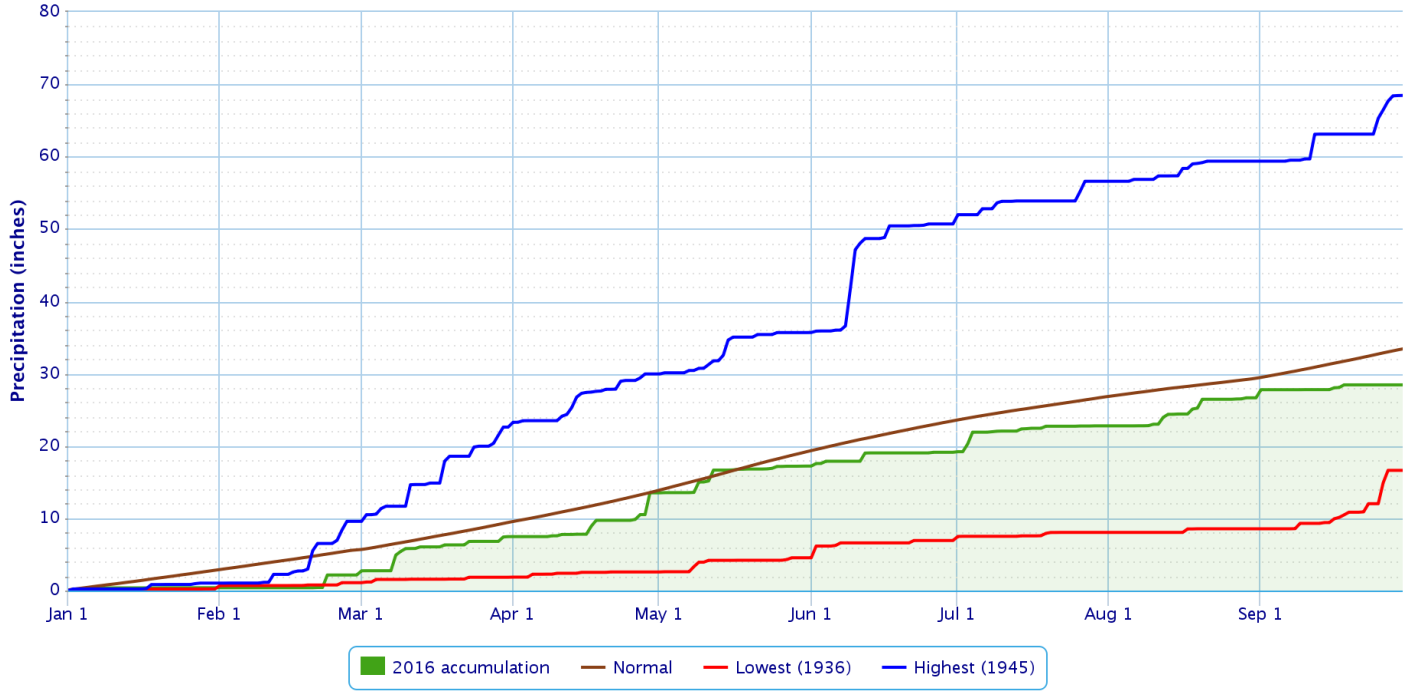
Period of Record – 1882-06-01 to 2016-10-03. Normals period: 1981-2010. Click and drag to zoom chart.



Powered by ACIS

Accumulated Precipitation – Fort Smith Area, AR (ThreadEx)

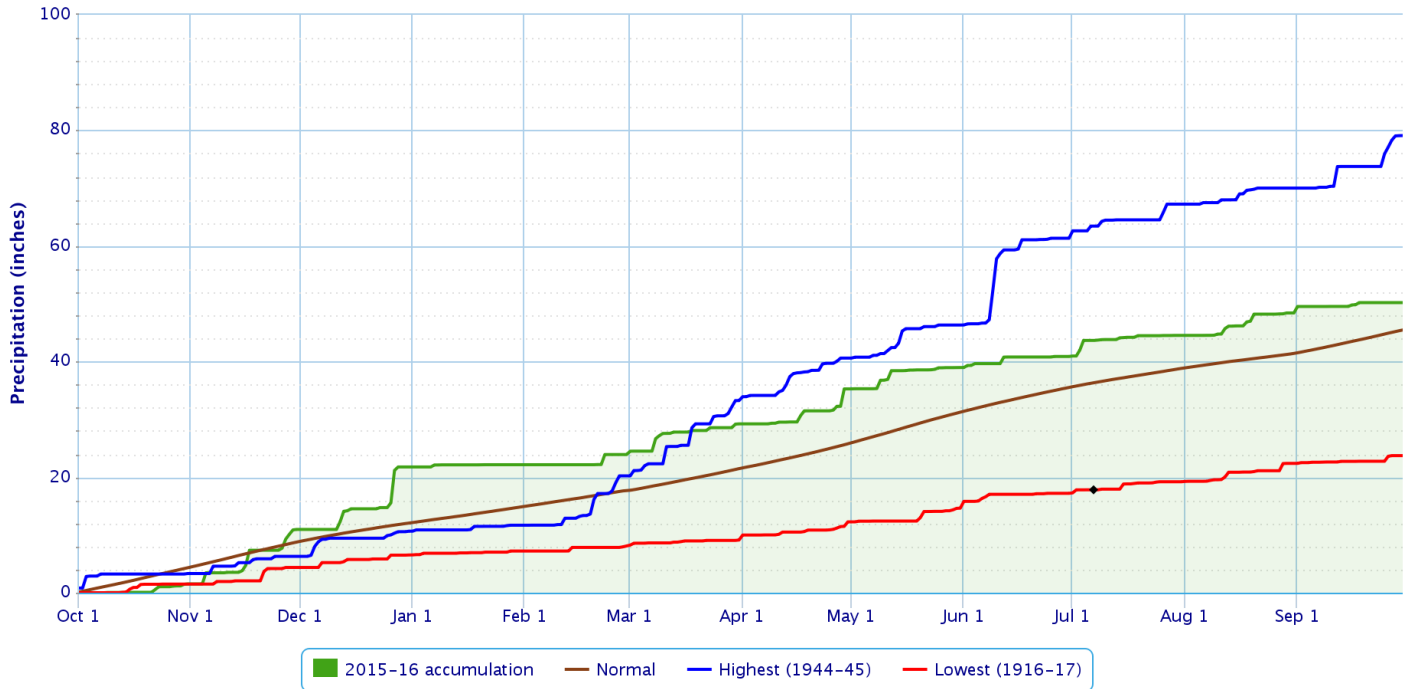
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

Accumulated Precipitation – Fort Smith Area, AR (ThreadEx)

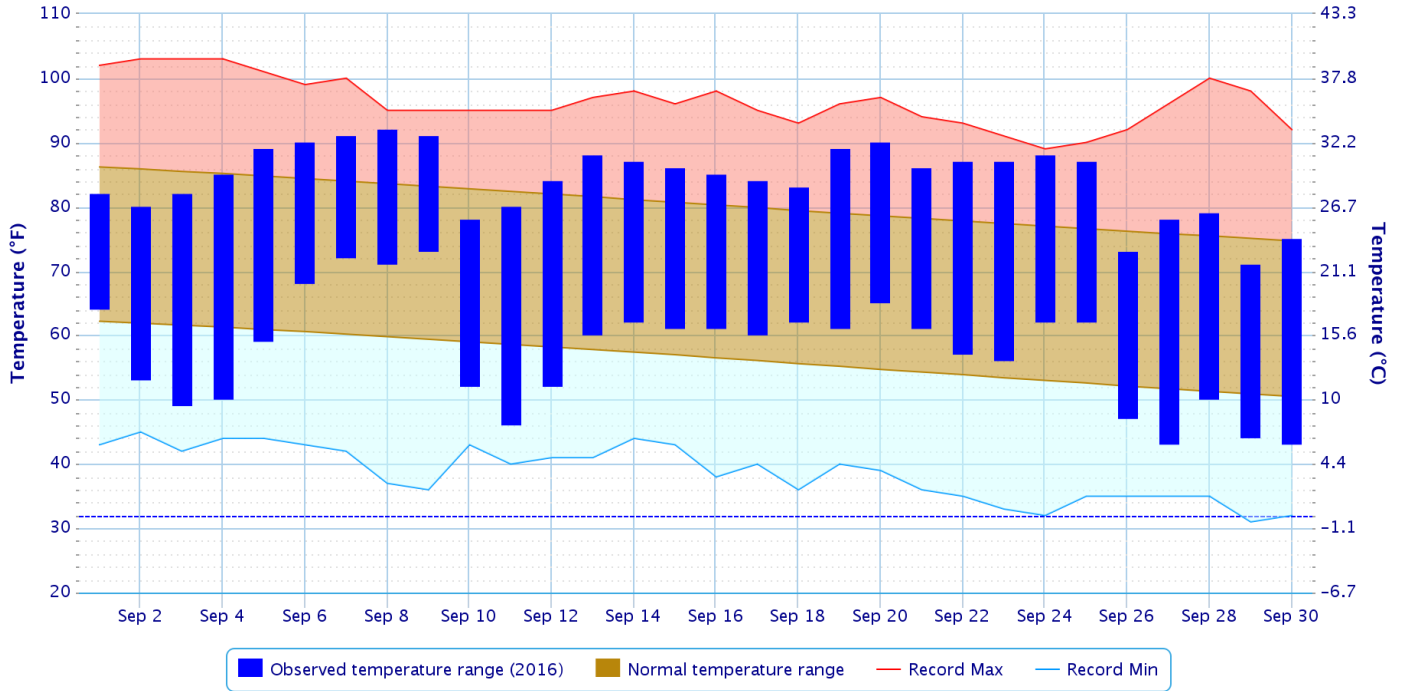
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

Daily Temperature Data – FAYETTEVILLE DRAKE FLD, AR

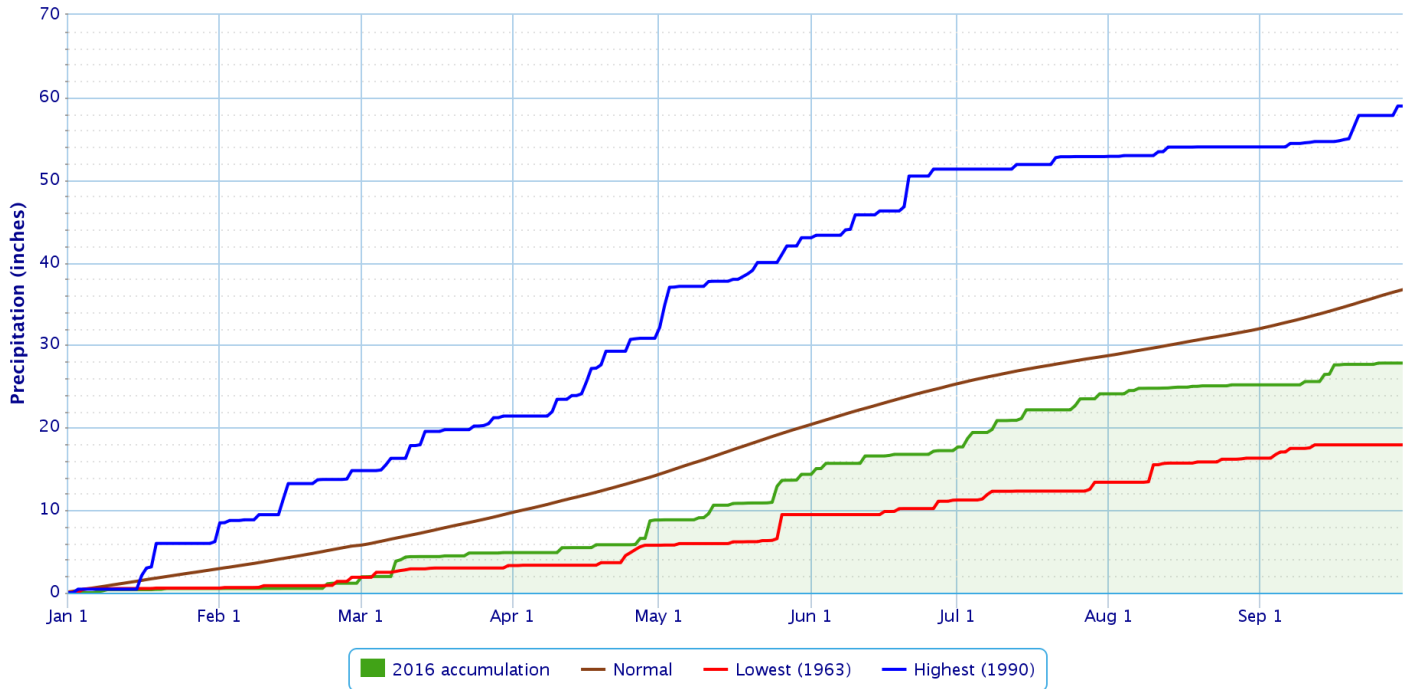
Period of Record – 1949-07-14 to 2016-10-03. Normals period: 1981-2010. Click and drag to zoom chart.



Powered by ACIS

Accumulated Precipitation – FAYETTEVILLE DRAKE FLD, AR

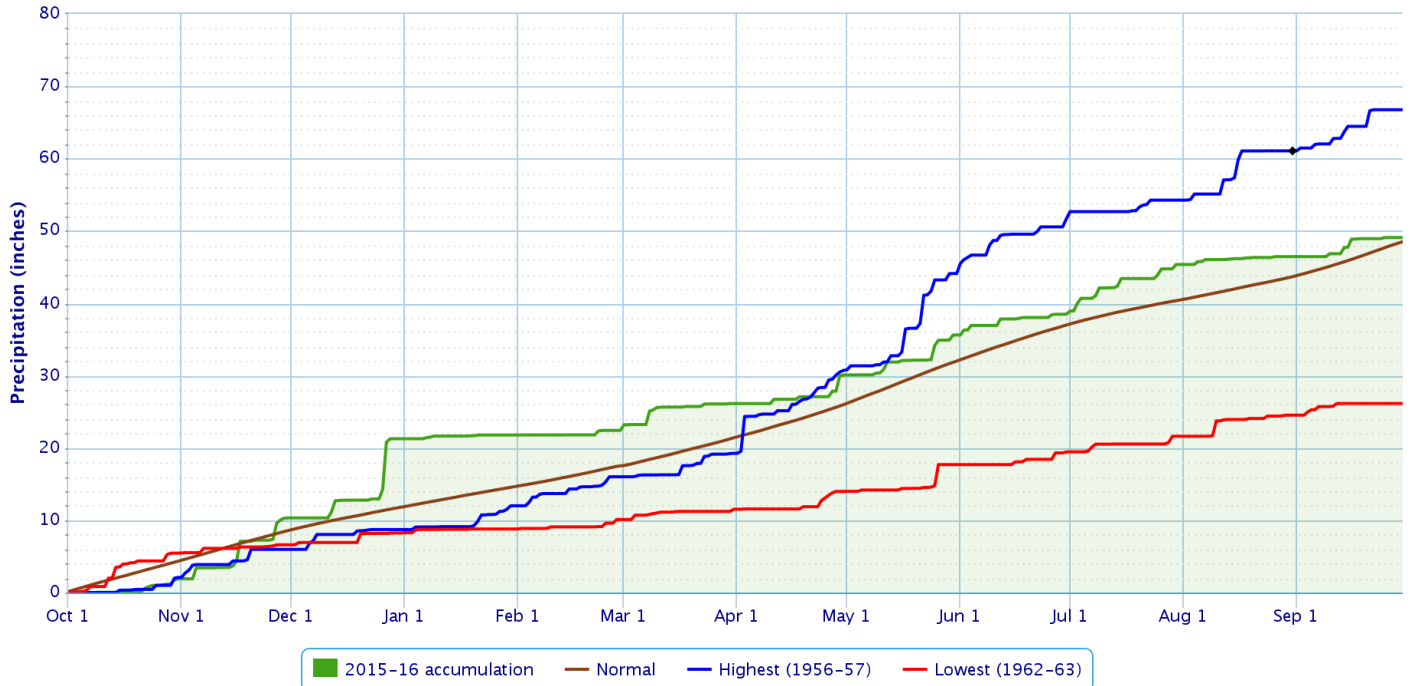
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

Accumulated Precipitation – FAYETTEVILLE DRAKE FLD, AR

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



Powered by ACIS

Water Year 2016 (Oct. 1, 2015-Sep. 30, 2016)

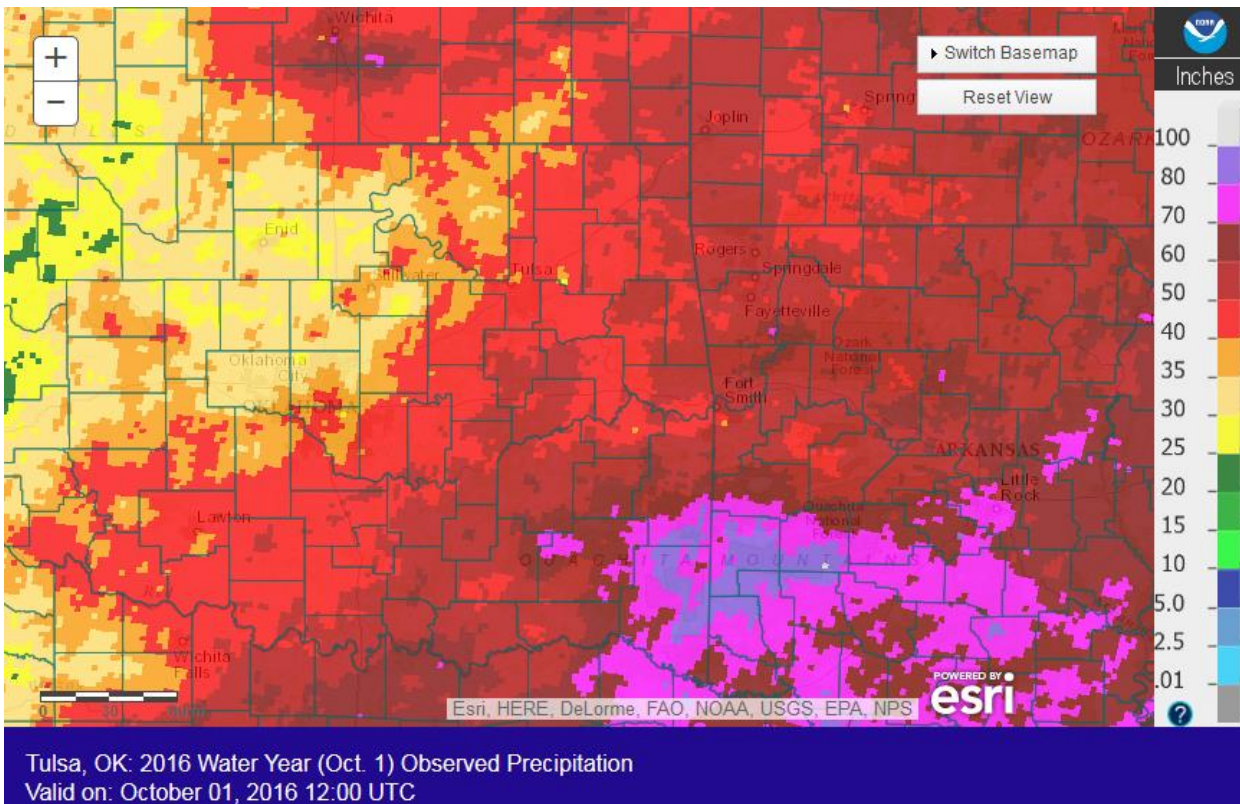


Fig. 2a. Estimated Observed Rainfall for Water Year 2016

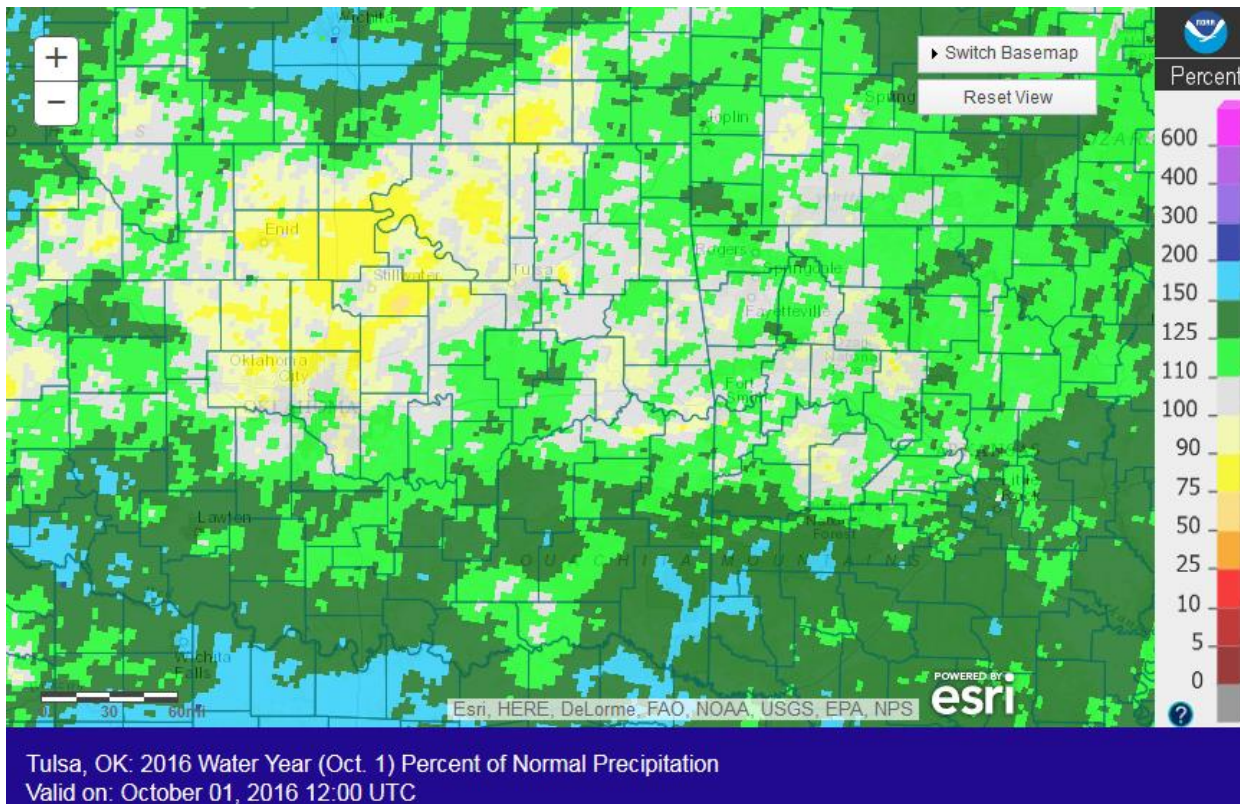


Fig. 2b. Estimated % of Normal Rainfall for Water Year 2016

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 2a), rainfall totals across eastern OK and northwest AR for Water Year 2016 ranged from 30” near Ponca City to around 80” in southeast OK. A large portion of the HSA received 40”-60” of rain this water year. This corresponds to 75% to around 150% of the normal Water Year rain for eastern OK and northwest AR (Fig. 2b).

Some of the larger precipitation reports (in inches) for Water Year 2016 included:

Winslow 7NE, AR (coop)	73.64	Bunch 0.8N, OK (coco)	64.55	Springdale 5.8ENE, AR (coco)	64.28
Upper Spavinaw Port, OK (coop)	62.44	Wilburton 9.4N, OK (coco)	62.00	Fanshawe, OK (coop)	59.85
Mountainburg 2NE, AR (coop)	59.46	Bengal, OK (coop)	59.44	Greenwood 1.4W, AR (coco)	59.29

Drought

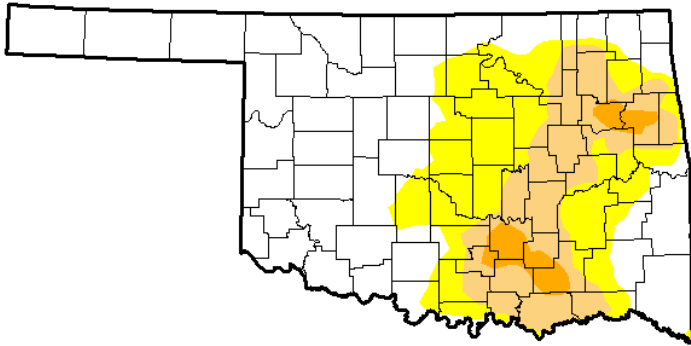
According to the [U.S. Drought Monitor](#) (USDM) from September 27, 2016 (Figs. 3, 4), D2 (Severe Drought) continued over Wagoner County and spread into Cherokee County. D1 (Moderate Drought) conditions existed over portions of Rogers, southern Washington (OK), Tulsa, eastern Creek, Okfuskee, Okmulgee, western McIntosh, Wagoner, Muskogee, Mayes, Cherokee, Adair, Delaware, far southern Nowata, and western Choctaw Counties in northeast OK. D0 (abnormally dry conditions but not in drought) were present across portions of Osage, Pawnee, Creek, Washington, Nowata, Muskogee, Okmulgee, McIntosh, Pittsburg, Mayes, Delaware, Adair, Sequoyah, Haskell, western Latimer, western Pushmataha, and Choctaw Counties in OK, and Benton and Washington Counties in northwest AR.

U.S. Drought Monitor Oklahoma

September 27, 2016
(Released Thursday, Sep. 29, 2016)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	57.82	42.18	19.04	3.05	0.00	0.00
Last Week 9/20/2016	55.17	44.83	13.24	2.39	0.00	0.00
3 Months Ago 6/28/2016	77.65	22.35	5.86	0.00	0.00	0.00
Start of Calendar Year 1/22/2015	100.00	0.00	0.00	0.00	0.00	0.00
Start of Water Year 9/29/2015	52.60	47.40	16.79	6.37	0.97	0.00
One Year Ago 9/29/2015	52.60	47.40	16.79	6.37	0.97	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:

Chris Fenimore
NCEI/NESDIS/NOAA



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

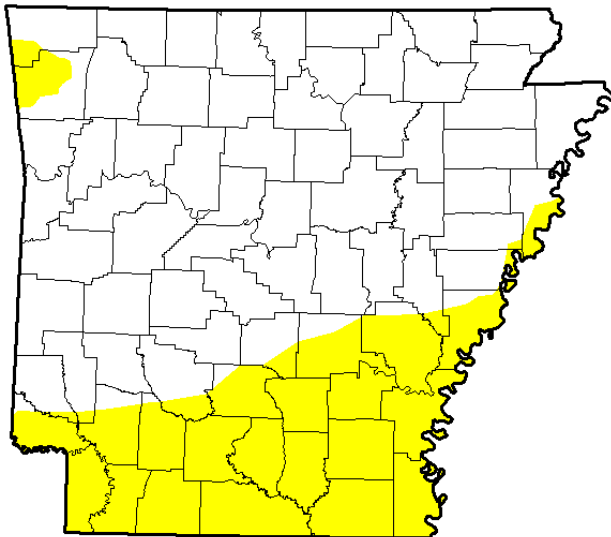
Fig. 3. Drought Monitor for Oklahoma

U.S. Drought Monitor Arkansas

September 27, 2016
(Released Thursday, Sep. 29, 2016)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	71.02	28.98	0.00	0.00	0.00	0.00
Last Week 9/20/2016	98.85	1.15	0.00	0.00	0.00	0.00
3 Months Ago 6/28/2016	94.91	5.09	0.00	0.00	0.00	0.00
Start of Calendar Year 1/22/2015	100.00	0.00	0.00	0.00	0.00	0.00
Start of Water Year 9/29/2015	39.30	60.70	42.41	16.89	4.64	0.00
One Year Ago 9/29/2015	39.30	60.70	42.41	16.89	4.64	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:

Chris Fenimore
NCEI/NESDIS/NOAA



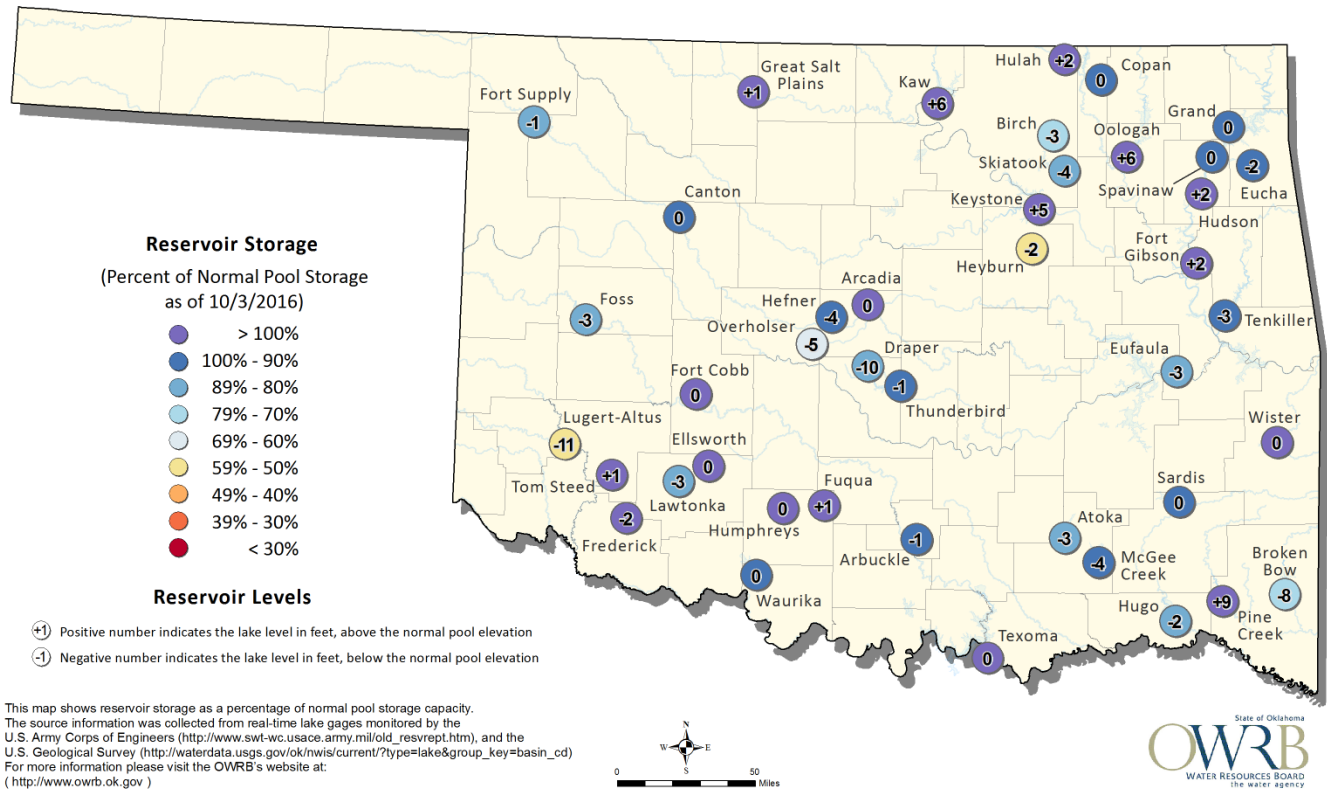
<http://droughtmonitor.unl.edu/>

Fig. 4. Drought Monitor for Arkansas

Reservoirs

Oklahoma Surface Water Resources

Reservoir Levels and Storage as of 10/3/2016



According to the USACE, several lakes in the HSA were below the top of their conservation pool levels as of 09/30/2016. A few reservoirs were operating above 5% of the top of their conservation level including: Oologah Lake 119%, Kaw Lake 119%, and Keystone Lake 113%. Reservoirs operating more than 5% below of the top of their conservation level include: Heyburn Lake 57%, Birch Lake 78%, Eufaula Lake 82%, Hugo Lake 83%, Beaver Lake 84%, Skiatook Lake 88%, Tenkiller Lake 91%, and Copan Lake 95%.

Outlooks

The [Climate Prediction Center](#) (CPC) outlook for October 2016 (issued September 30, 2016) indicates an enhanced chance of above normal temperatures across all of eastern OK and northwest AR. This outlook also calls for a slightly enhanced chance for below median rainfall over southeast OK through northwest AR and equal chances for above, near, and below median precipitation elsewhere across northeast OK. This outlook is based on both short- and extended-range weather forecasts, which indicate ridging and southwesterly flow early in the month across eastern North America.

For the 3-month period October-November-December 2016, CPC is forecasting a slightly enhanced chance for above normal temperatures across all of eastern OK and northwest AR. This outlook also calls for a slightly enhanced chance for below median precipitation south of Hwy 412 and equal chances for above, near, and below median precipitation north of Hwy 412 (outlook issued September 15, 2016). According to CPC, Pacific sea surface temperatures along the equator indicate ENSO-neutral conditions (near average) continue. This outlook is based primarily on both statistical and dynamical forecast tools and decadal timescale climate trends. The chance of ENSO-neutral conditions is now 55%-60% through the fall and winter, though borderline La Niña conditions are possible.

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

September 1-15

Showers and thunderstorms developed during the early morning hours of the 1st and progressed southward through the morning and afternoon hours as an upper-level wave moved south across western KS. The rain came to an end from north to south as a cold front moved through the area. Due to the slower movement of the storms, several areas received 0.50" to 1.5" of rain, with isolated higher totals of 1.5"-3".

Convection developed along nearly stationary front over southern KS and western MO on the 8th, with scattered storms continuing through the day. A few of these storms worked their way south into northeast OK and northwest AR. The storms along the front increased in coverage and intensity by midnight on the 9th as the low level jet increased, with heavy rain continuing through the overnight hours. By 7am on the 9th, widespread 2"-8" of rain had fallen across southern KS, affecting the Neosho, Verdigris, and Upper Arkansas River basins. 0.50" to around 4" also fell across far northeast OK and far northwest AR (Fig. 5). Shortly before sunrise on the 9th the low level jet increased again, and thunderstorms developed along an outflow boundary over northeast OK in the vicinity of the I-44 corridor. These storms then dissipated by noon. During the evening, storms once again fired along the cold front in southern KS, exacerbating the ongoing flooding there. These storms quickly developed into a line from western OK into western MO. The line of storms crossed into OK during the late evening hours, and continued to move south and weaken through the overnight hours. The last remnants of the storms dissipated by noon on the 10th. Locations north of an Okemah to Springdale line received the heaviest rainfall of 0.50" to near 3" (Fig. 6), while elsewhere, totals were around 0.25" or less. Area reservoirs prevented flooding in Oklahoma on the Verdigris and Arkansas River basins. However, the heaviest rain fell south of the John Redmond Dam along the Neosho River, resulting in minor to nearly moderate flooding along the Neosho River in northeast OK to Grand Lake (see preliminary hydrograph at the end of this report).

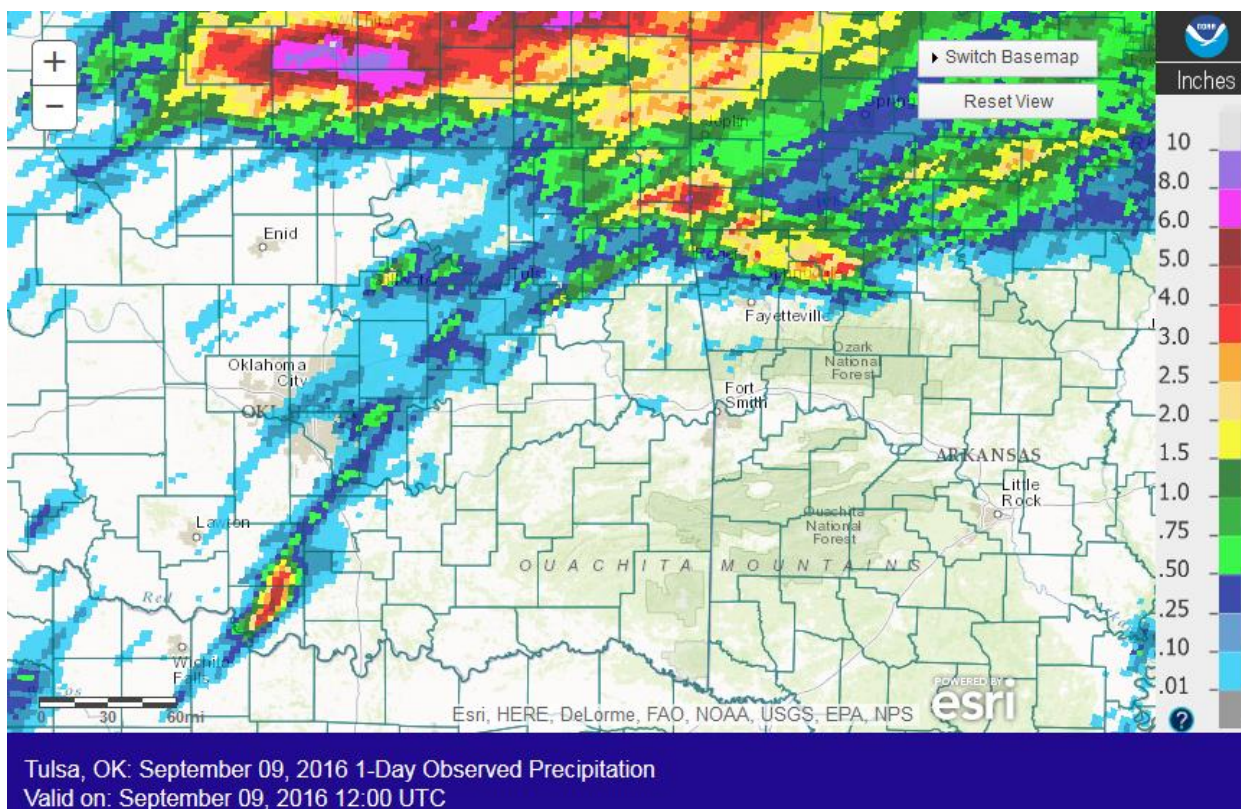


Fig. 5. 24-hour Estimated Observed Rainfall ending at 7am CDT 9/09/2016.

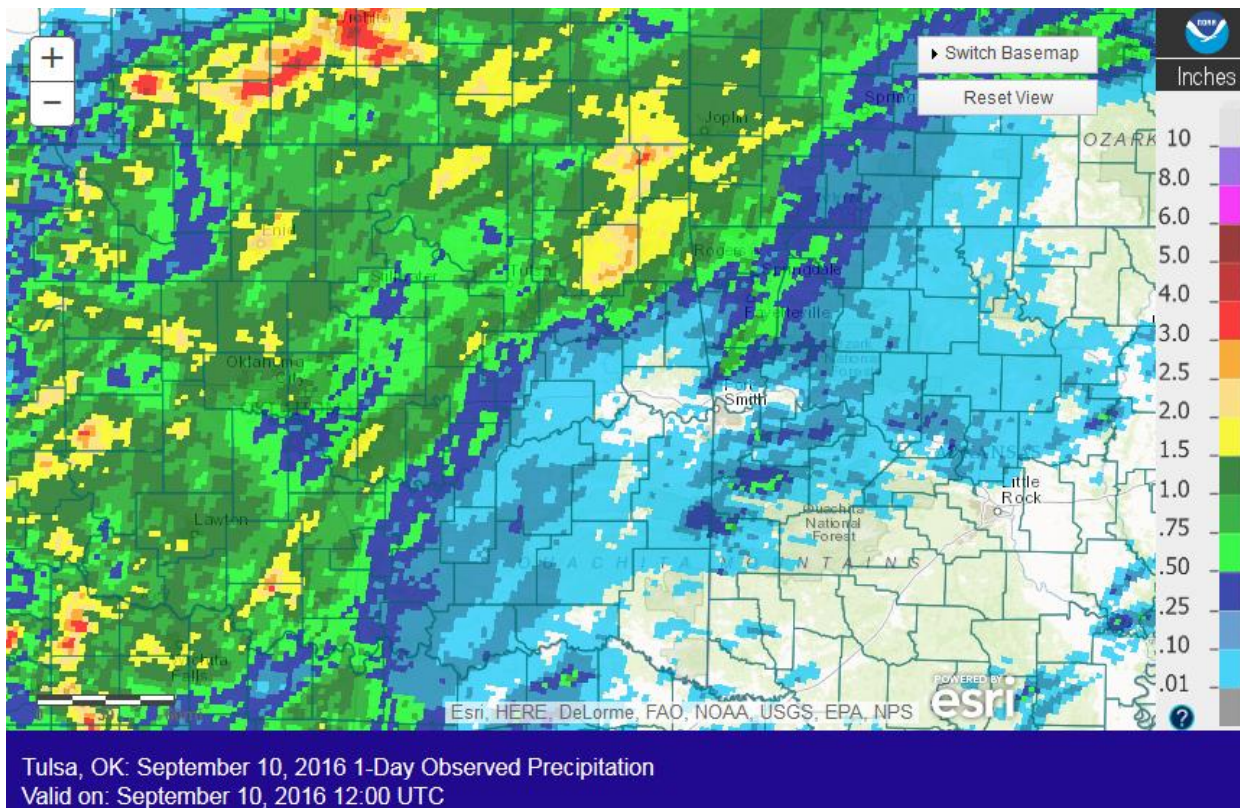


Fig. 6. 24-hour Estimated Observed Rainfall ending at 7am CDT 9/10/2016.

A cold front sagged south into the region after midnight on the 14th, stalling from Okfuskee County up through the northeast corner of OK. A few isolated storms developed near the front over Osage, Washington, and Tulsa Counties during the overnight hours, dissipating by sunrise. Rainfall amounts were 0.10" to around 1.5". Additional storms developed during the morning of the 14th over far northeast OK. Scattered showers and thunderstorms then developed south of the front around noon. While most of the activity remained south of I-44, a few storms moved north of the interstate during the evening as the front lifted back north. Most of the affected area received 1.5" or less of rain, but a few locations received 1.5" to near 3" of rain.

Widely scattered showers and thunderstorms again developed across eastern OK and northwest AR on the 15th ahead of the cold front as it returned south and in response to an approaching upper-level wave. Once again, a few localized areas saw 1.5" to near 3" of rain, while most places received around 1" or less.

September 16-30

Through the morning hours of the 16th, two separate mesoscale convective systems (MCS) moved into eastern OK and converged. One moved south out of KS while the other was dissipating as it moved northeast out of south central OK. The storms then move east southeast, generally affecting eastern OK and northwest AR north of I-40 through the afternoon. By evening, the storms developed into a scattered line along an outflow boundary from southeast OK to northwest AR. This activity exited the region before midnight. Most of eastern OK and northwest AR received rain from this event, with totals ranging from around 0.10" to near 3" in a couple of locations (Fig. 7). Widespread 1"-3" of rain fell over southeast KS in the Neosho River basin, resulting in minor flooding along the Neosho River near Commerce (see preliminary hydrograph at the end of the report).

During the evening hours of the 17th, an area of showers and thunderstorms moved out of central OK and across east central and southeast OK south of a Bristow to Fort Smith line. A second complex of showers and thunderstorms affected the same area during the early morning hours of the 18th, but these storms continued into northwest AR after sunrise. By mid-morning the storms were east of the HSA. Rainfall totals ranged from 0.25" to around 2.5" (Fig. 8).

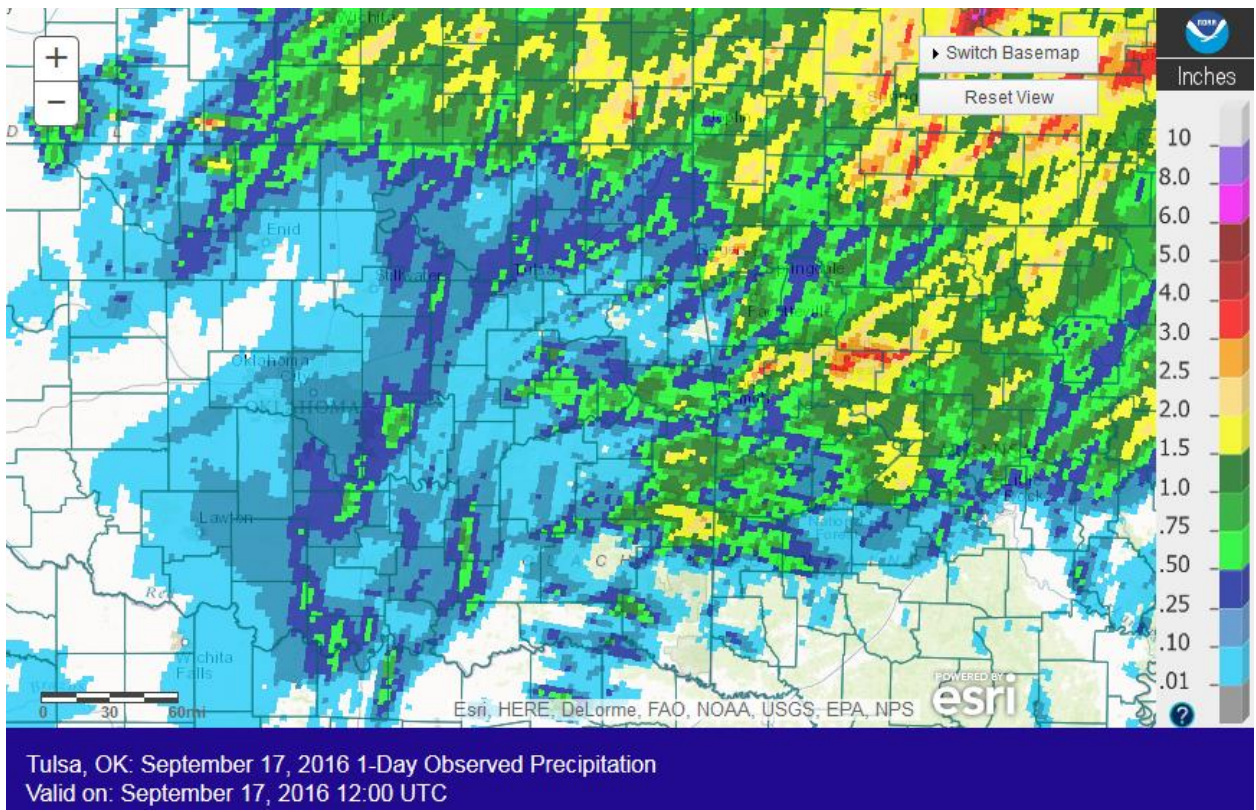


Fig. 7. 24-hour Estimated Observed Rainfall ending at 7am CDT 9/17/2016.

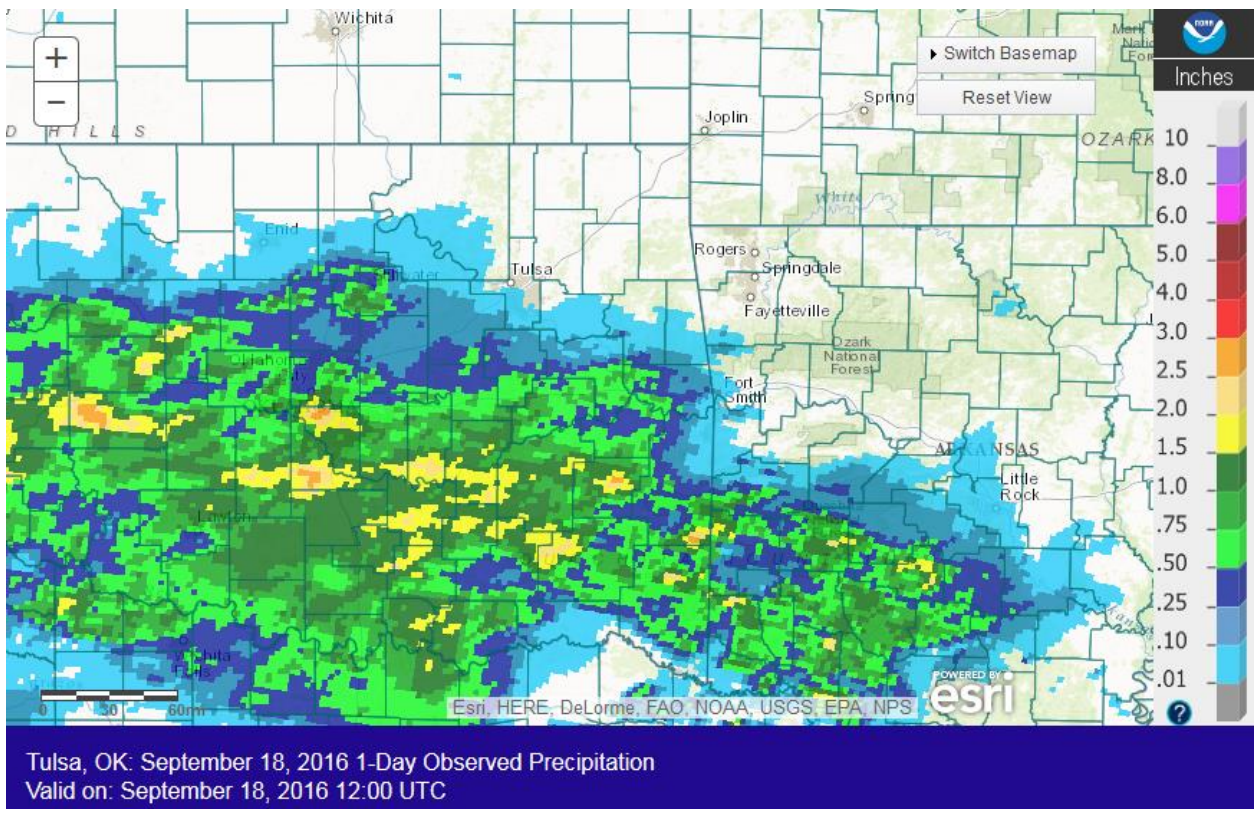


Fig. 8. 24-hour Estimated Observed Rainfall ending at 7am CDT 9/18/2016.

Mid- to late-evening on the 24th, a line of thunderstorms moved east into north central and northeast OK. These storms quickly dissipated over northeast OK with the loss of daytime heating, while an area of storms persisted through the overnight hours over central OK, just west of the HSA. In the hours before sunrise, this area of showers and thunderstorms had moved slightly east, affecting northeast OK west of Hwy 75. This brought 0.25" to near 3" of rain to locations west of Hwy 75 (Fig. 9). Only isolated showers remained by noon

on the 25th; however, a cold front then moved into the region, sparking new convection during the afternoon. Showers and isolated thunderstorms continued into the morning hours of the 26th and finally exited the region as the front moved east. Rainfall totals were 0.10" to around 1.5" for portions of eastern OK and northwest AR (Fig. 10).

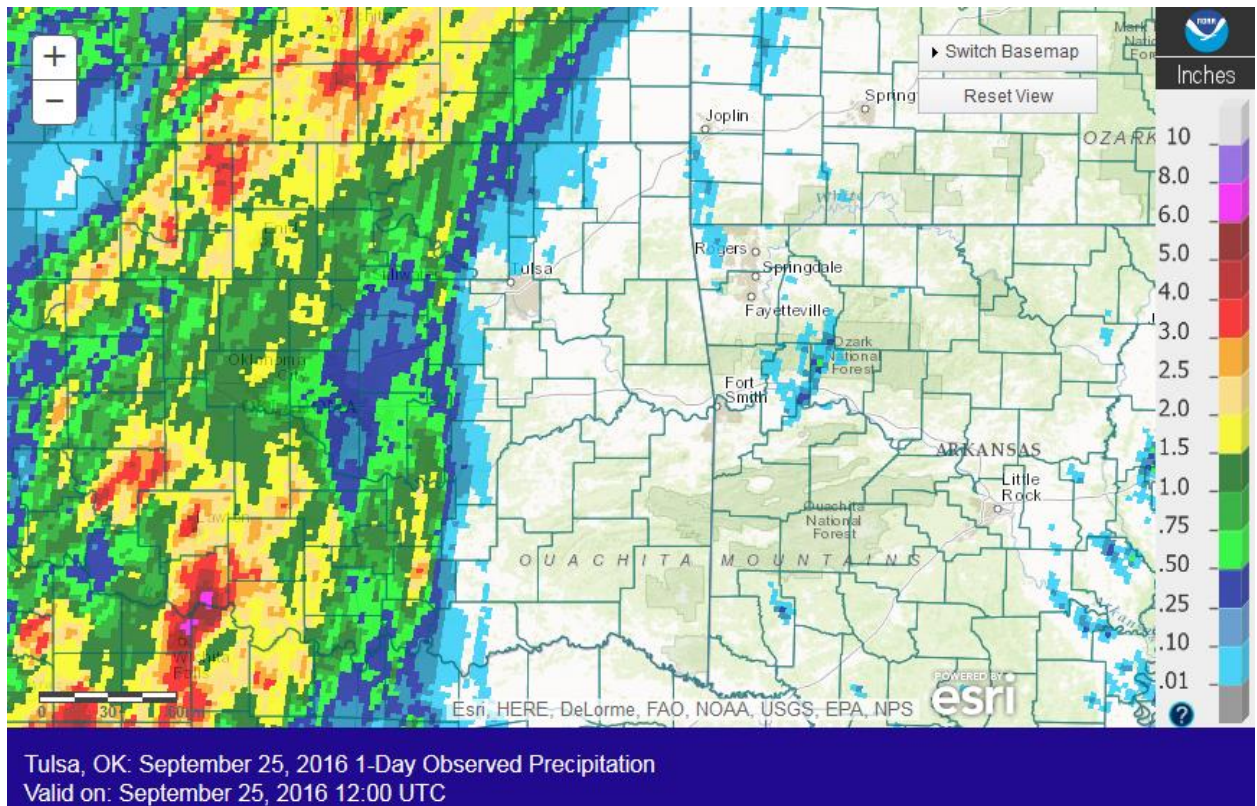


Fig. 9. 24-hour Estimated Observed Rainfall ending at 7am CDT 9/25/2016.

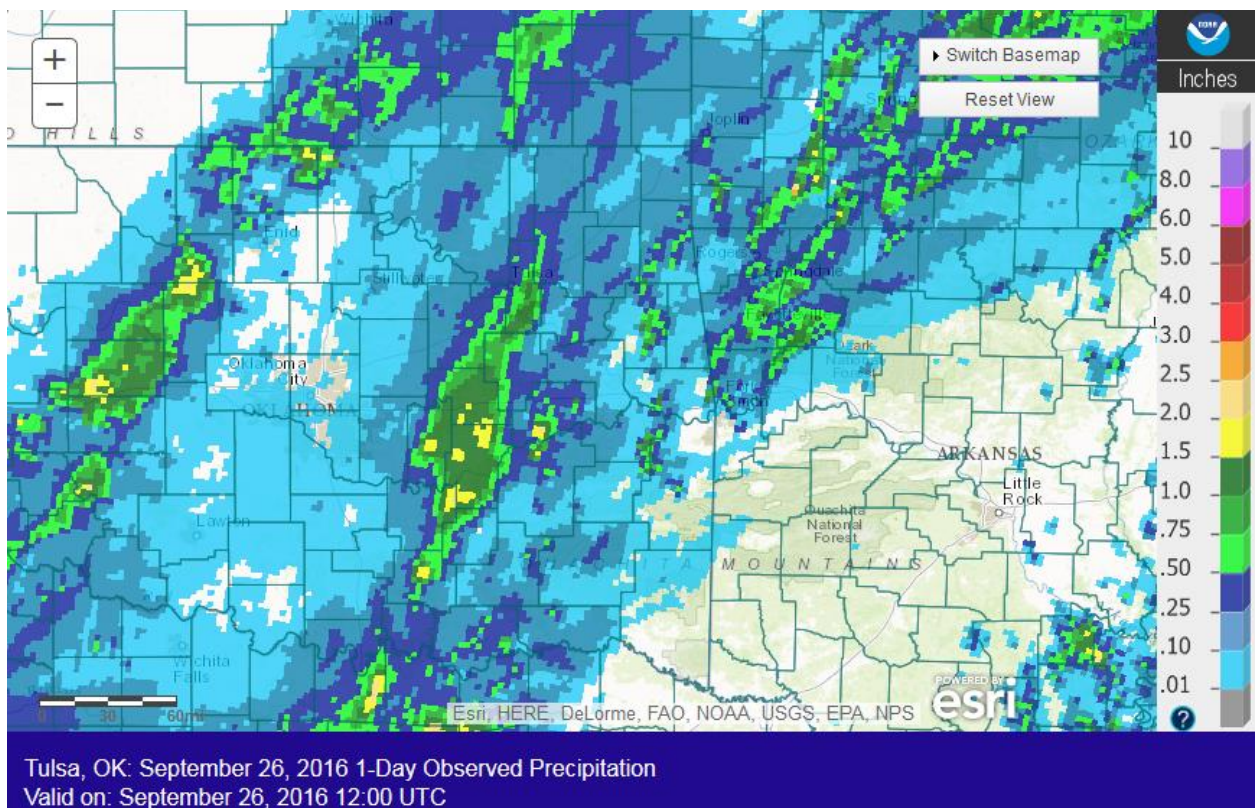


Fig. 10. 24-hour Estimated Observed Rainfall ending at 7am CDT 9/26/2016.

Written by:

Nicole McGavock
Service Hydrologist
WFO Tulsa

Products issued in September 2016:

*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

- 4 Flash Flood Warnings (FFW)
- 6 Flash Flood Statements (FFS)
- 0 Flash/Areal Flood Watches (FFA) (0 Watch FFA CON/EXT/EXA/EXB/CAN)
- 11 Urban and Small Stream Advisories (FLS)
- 0 Areal Flood Warnings (FLW)
- 0 Areal Flood Statements (FLS)
- 2 River Flood Warnings (FLW)
- 27 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)
- 0 Hydrologic Outlooks (ESF)
- 0 Drought Information Statements (DGT)

Preliminary Hydrographs:

